VOOM Model:
Digital Learning Excellence in VET MOOCs

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Declaration of Originality

This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.

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Statement of Ethical Conduct

The research associated with this thesis abides by the international and Australian codes on human and animal experimentation, the guidelines by the Australian Government's Office of the Gene Technology Regulator and the rulings of the Safety, Ethics and Institutional Biosafety Committees of the University. The Human Research Ethics Committee (Tasmania) Network ethics reference number for this research is H0015193.

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List of Abbreviations, Acronyms and Other Terms

AQF	Australian Qualifications Framework
AQTF	Australian Quality Training Framework
ASQA	Australian Skills Quality Authority
CBT	Competency Based Training
CFA	Confirmatory Factor Analysis
CIT	Canberra Institute of Technology
cMOOC	Connectivist Massive Open Online Course
e-Learning	Electronic Learning
Formative assessment	The process of monitoring how well a learner is understanding the course materials
HE	Higher Education
IT	Information Technology
MOOC	Massive Open Online Course
Nominal Hours	The number of hours attached to a unit of competency (UoC)
PCA	Principal Component Analysis
RPL	Recognition of Prior Learning
SEM	Structured Equation Modelling
SJR	SCImago Journal Rank
SLR	Systematic Literature Review
SPOC	Small Private Online Course
Student	Interchangeable with "learner"
Summative assessment	The final course tasks to confirm the learner's achievement of the knowledge, skills, and unit of competency outcomes
Topology	The "study of the way in which constituent parts are interrelated or arranged" (English Oxford Dictionaries, 2019)
UOC	Unit of Competency
URL	Uniform Resource Locator or web address
VET	Vocational Education and Training
VR	Virtual Reality
xMOOC	Extended or Extension Massive Open Online Course

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Abstract

Technology-rich online learning environments are exponentially transforming the landscape of higher education and changing global learning communities. This is a radical shift, as the approaches to sustainable web delivery extend existing online models to exploit free and accessible education through the Massive Open Online Course (MOOC) initiative. As contemporary MOOC literature is mainly focused on university developments which are coupled with high learner withdrawals and poor engagement, sustaining learners in web-based environments is a recurring theme for many educational systems around the world. Accordingly, the Vocational Education and Training (VET) sector has been reluctant to connect with the benefits of MOOCs as a teaching and learning tool and consequently, there is an incomplete picture of the way this tool performs in this sector. As VET moves away from traditional forms of delivery, it is important to examine how VET students perceive their e-Learning experiences and the andragogical practices for effectively retaining and engaging these learners.

This study investigated VET MOOCs, Small Private Online Courses (SPOCs) and online courses offered by the Canberra Institute of Technology (CIT) with the aim of identifying the themes, components and functional approaches that stimulated learner engagement and encouraged retention. This evolutionary research used continuous improvement mechanisms to discover design enrichments for each subsequent MOOC over three years of multiple course iterations. Each improvement was guided by the four research predictors: sense of community, course content flow, assessment structure, and instructor accessibility.

A conceptual framework was developed to interconnect the five research questions to the theoretical perspectives and methodological practices of the study. Then, an action research investigation appraised 11 MOOCs, 6 SPOCs, and 6 online learning courses with 683 consenting participants involved in the study. The research methodology instigated scientific method for quantitative data analysis and purposeful qualitative sampling of recurring variables with an

evaluation of tangible learner perceptions summarised in response to the research inquiry.

Through this evolutionary journey of learners in fully online technology-rich environments, the learners' capabilities and their receptiveness to each learning mode fostered the development of the VOOM model. The VOOM model combines the most effective techniques for enhancing the students' learning experiences into a best-practice application that promotes digital learning excellence in VET MOOCs. Even though the model was derived from the science discipline of Biometric Technologies and had a VET focus, the outcomes classified by the model offer practical strategies to better engage and retain learners in MOOC and online courses. Further work is required to establish its applicability in other discipline contexts.

VOOM encouraged learner inclusion and a sense of community through collaborative mechanisms comprising of social networking opportunities, discussion boards, and optional content-related discussion forums. Awarding a MOOC certificate enticed learners to persist in the course as did offering further academic pathways to extend professional and career development opportunities. The desire and influence of learners to advance in a free learning program was enhanced by a positive course experience. Additionally, the systematic release of course content and quality instructional course designs that incorporate interactive tools and blended connectivism and andragogy, and thus promoted student retention. The learner's capacity to achieve was heightened when students had previous online experience or prerequisite entry requirements were enforced. Furthermore, well-developed competency-based formative assessments fostered stronger learner commitment and engagement. Learners' demonstrated competency in skills and knowledge through a summative assessment. The instructor was visible on discussion boards, accessible through online forums/email and committed to globally contextualised communication by sending an initial welcome email, weekly article links, and weekly topic summaries. The negative impact of engagement and retention was further reduced with condensed study durations and short course timeframes. Also, learner participation was improved when week-one course materials were innovative, manageable and interesting.

The inclusion of the VOOM techniques from this study contributed to a 10% increase in student completions. When this is considered in comparison to the NCVER (2018) statistics for 2016, a 10% increase from 43% to 53% in the number of students completing their VET courses would be worth $605 million to the economy and reduce the future debt of VET FEE-HELP recipients by $182 million. This could be of real economic benefit to Australia and similarly to global education.

The 12 recommendations detailed from the findings are intended for practical implementation by instructors, course designers, and educational institutions. They are not only suitable for VET providers but, in practice, they could offer a clear pathway towards better learner engagement and retention for all educational organisations that offer technology-rich online learning. Finally, based on the outcomes of the research, a new definition of engagement and retention is proposed:

> *Engagement and retention are the learners' judgement of success through improved knowledge and skills, and their ongoing recommendations to others.*

1 INTRODUCTION

Future proofing careers and preparing learners as digital technologies advance are major challenges for the VET (Vocational Education and Training) sector. Work that was once done by people is becoming automated, and into the future individuals will have multiple careers, need flexible study options and alternative learning pathways. Ironically, fully online technology-rich learning models can deliver the educational support required to accommodate future VET learners. As innovative teaching and learning tools, MOOCs (Massive Open Online Courses) and SPOCs (Small Private Online Courses) in addition to online delivery modes, extend instructional pathways for the VET sector, with access to a broader cohort of learners, as anyone with web access is a prospective student. However, as university MOOCs are often afflicted by low learner engagement and retention rates, there is apprehension on the conduciveness of web-based learning environments to offer quality vocational learning experiences. Consequently, exploring the in-depth aspects of retention and engagement in VET MOOCs, SPOCs and online delivered courses may pave the way for technology-rich online delivery as a preferential teaching and learning model for VET.

MOOCs are revolutionary for learners as “nothing has more potential to lift more people out of poverty” (Friedman, 2013, p. 1). The opportunity for students to engage in free learning has seen MOOCs increase by 392% over the past three years, 2015-2018 but a preliminary audit reveals that only a few VET providers in Australia are offering this form of learning model. MOOCs expand educational sustainability and could enhance VET capabilities by delivering timely and relevant vocational education to learners on a global scale. The worldwide demand for knowledge-based learning can be achieved through

MOOCs, but empirical research focused on MOOC completions in higher education spotlights low retention rates and poor learner engagement (de Freitas, Morgan, & Gibson, 2015; Green, Oswald, & Pomerantz, 2015; Hew, 2014; Khalil & Ebner, 2014). Consequently, low completion rates are considered to be one of the possible factors for the deterioration of MOOCs into the future (Green et al., 2015), but this reduction has yet to be seen. In addition to this, low learner engagement and retention rates have been identified by the key Australian advisory body for VET online learning as an imminent concern for VET organisations pursuing MOOC delivery models (Flexible Learning Advisory Group, 2013).

In contrast, there are many inherent advantages of MOOCs. In MOOCs, conventional class-size restrictions are removed as they scale for a very larger number of learners to study simultaneously (Khalil & Ebner, 2014; Maringe & Sing, 2014). This could give VET the enhanced ability to accommodate global upsurges in skills shortage areas and more effectively meet the future demands of industry. The MOOC model offers equitable learning, giving less privileged learners the opportunity to attain knowledge and skills for free (Department for Business Innovation & Skills (BIS), 2013; Friedman, 2013). But free education is not sustainable if operating costs cannot be recovered. Therefore, fees can be attributed to the Recognition of Prior Learning (RPL) skills assessments which are conducted before deeming the learner competent for the unit. The flexible aspects of MOOCs are beneficial as learners can study “just in time” which improves course completions (Rubens, 2014) and an ongoing aspiration for most educational providers. However, are MOOCs a justifiable expense for VET providers that are contending with ongoing financial pressures and government funding cuts? Encouragingly, VET teachers are already quite tech-savvy as printed content is commonly transferred into an online format to reduce printing costs. Information Technology (IT) infrastructure is increasingly cheap to upgrade, and e-Learning platforms are more sophisticated and user-friendly. Additionally, the availability of free or relatively inexpensive innovative online learning tools can easily be incorporated into in-house developed video or learning content to create a quality learning experience. Together, these can benefit VET organisations by reducing capital expenditure on physical resources, condensing teacher training time and decreasing professional development costs. The added benefits for the MOOC learner are the elimination of travel expenses, no travel time and the opportunity to study within an international student cohort.

To take full advantage of MOOCs, VET providers need to be persuaded that a MOOC delivery model is a viable and cost-effective way to deliver education. An empirical study that compares VET MOOCs with other fully online technology-rich learning models such as SPOCs (Small Private Online Courses) and online delivered courses could determine the factors that are most conducive to learner engagement and the elements that foster higher learner retention might alleviate these concerns. The research outcomes could then be developed into a model that supports digital learning excellence in VET MOOCs and generate recommendations for best-practice.

1.1 Study focus and aims

The focus of this study was to delve more closely into engagement and retention with an emphasis on technology-rich online learning for VET students. The central aspects of this research were to explore how VET students perceived their course experience, to gain a deeper understanding of how VET students learn best and the key aspects that motivate learners to finish their course. A theoretical understanding of student engagement and retention attributes in VET MOOCs was also established and these formed the baseline for this inquiry. To understand these relationships, learners studying in technology-delivered courses delivered by CIT (Canberra Institute of Technology) could be examined to identify possible factors that contributed to better learner completions. Although the study was completed in an Australia context, it was globally aware and sought outcomes with world-wide relevance.

CIT, and in particular its Forensic Science Department, has used online delivery modes for many years. To broaden the geographical reach of course offerings they recently expanded into MOOC and SPOC models. As it is unknown how each learning environment affects a VET learner's ability to achieve, it was crucial to analyse and compare MOOC, SPOC and online learning modes. The factors that were most conducive to learning, or even if that delivery mode should be adopted, could be explored through multiple iterations of these courses. Initially, the research would need to source empirical literature to form the continuous improvement mechanism which would become the backbone for the research predictors. Then by implementing the research predictors in an action research inquiry, engagement and retention factors could be identified. These factors could then inform the research for the next MOOC and SPOC iteration. The outcomes from the research predictor analysis and the factors that most suited VET learners could then be incorporated into a further MOOC and SPOC for validation and triangulation of findings. Qualitative and quantitative analysis of learners between and across learning environments could be used to verify the most suitable factors that improved engagement and retention. These factors could then be developed into a graphical illustration of the best-practice findings and recommendations specifically established for VET MOOCs. The study followed a six-step process to provide a focused and systematic approach as follows:

1. *Plan* encompassed a systematic review of literature on engagement and retention in fully online technology-based courses, to determine the research questions and research predictors.
2. *Action* gathered learner data from MOOCs 1-10, SPOCs 1-5 and Online courses 1-5.
3. *Observe* scrutinised and triangulated data against the research predictors over multiple course iterations.
4. *Reflect* identified the most compelling predictor outcomes and then validated them in MOOCs 11a-11e, SPOC 6 and Online course 6.
5. *Analyse* appraised the quantitative and qualitative data for all courses in-line with the research questions, to detail the research findings.
6. *Outcomes* from the findings were used to generate reliable conclusions and recommendations.

A diagrammatic overview of the study is presented in Figure 1.

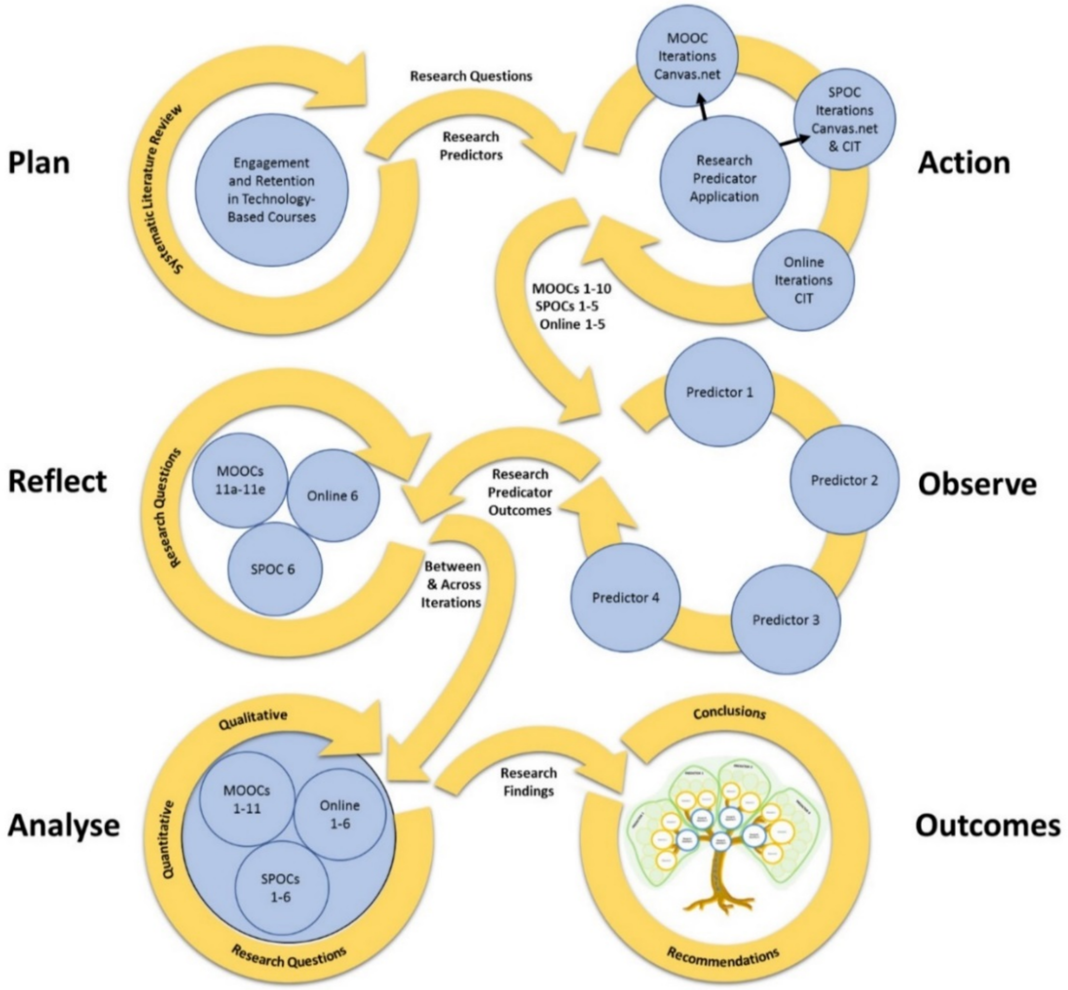


Figure 1. Overview of the study.

Through the exploration of students who frequent VET MOOCs, SPOCs, and other online courses, this research aims to make a significant contribution to the literature and to potentially establish the key aspects that foster greater levels of learner engagement and stimulate retention.

1.2 A snapshot of Vocational Education and Training (VET)

VET, as a higher education system, delivers workplace-specific skills and knowledge to both young adults and mature learners, in the form of training packages, accredited courses and discrete units of competency (UoCs). VET nomenclature is globally recognised as an international learning model across 21 countries and in some states throughout the United States of America

(Organisation for Economic Co-operation and Development (OECD), 2014). VET generally offers lower-level qualifications from Certificates I to IV, diplomas and advanced diplomas. Universities provide bachelor's degrees, graduate certificates, graduate diplomas, masters and doctoral degrees. Although both VET and universities reside in higher education, VET courses deliver practical hands-on competency-based learning whereas universities provide a more theoretical academic focus. Even so, there is cross over between both sectors as CIT offers bachelor's degrees and graduate certificate qualifications and some universities award diplomas and advanced diplomas.

In Australia, VET is regulated by the Australian Skills Quality Authority (ASQA) and overseen by Commonwealth, State and Territory governments. VET accredited courses "have the capacity to address changes in skill needs, and the needs of emerging and converging industries and industry sectors, in a responsive manner" (Australian Skills Quality Authority (ASQA), 2017, p. 1) and developed in consultation with Skills Service Organisations and Industry Reference Committees. The Australian VET system is underpinned by the Australian Qualifications Framework (AQF) and the Australian Quality Training Framework (AQTF). Together, these frameworks provide assurance for the national consistency of qualifications and the quality of industry training delivered by VET providers across Australia (Australian Government, 2016).

VET fosters the values, knowledge, and skills to address workplace shortage issues and this is particularly important as advancing technologies and communication immediacy is rapidly changing the way individuals live and work. As workplaces transform, vocational education needs to keep pace with social, economic and technological advancement and for the first time VET is required to forecast future skills and knowledge "for a type of society which does not yet exist" (Faure, 1972, p. 13). To accommodate this, the VET curriculum uses Competency Based Training (CBT), UoCs, foundation skills and RPL (Recognition of Prior Learning) as pathways to enable learners to gain a full qualification. CBT is fundamental to teaching and learning in the VET sector and for UoC development. As CBT is outcome focused, the measurement of achievement is through the learner's demonstration of abilities and transferability of knowledge and skills to complete work tasks (Dempsey, 2013). This makes CBT very amenable to diverse multi-channelled training delivery by catering to global trends which are consistently shaping education (Kamenetz, 2015). The UoC specifies the generic elements, performance criteria, foundation skills, assessment conditions and the performance requirements the learner needs to demonstrate in order to be deemed as competent. Competency achievement measured in this way acknowledges that the learner is capable and industry-ready to complete that work task.

1.3 Background to the research

The biometrics industry is gaining greater momentum as digital security technologies expand. The Australian government has recently implemented biometric systems as part of an overall national security policy platform. Internationally there is also a rapid push for technologies that give individuals more secure identification. With this increasing need for qualified biometric personnel, industry and government organisations approached CIT and requested an industry-specific course to accommodate the immediate and future needs of their industry. The industry consultation process was time-consuming, but it did highlight a significant need for trained biometric technicians. In conjunction with biometric security professionals and guided by the AQTF and AQF frameworks, CIT set out to develop a course to qualify these workers. During this time CIT also offered an innovative funding opportunity. The submission of a MOOC model was a tempting marketing strategy and a style of delivery not previously envisaged. A MOOC is a freely available course "aiming at large-scale interactive participation and open access via the web" (Littlejohn, 2013, p. 2). Additionally, there was no MOOC in the marketplace that offered learners an understanding of biometric technologies or how the individual's physiological and behavioural mechanics can be used to secure personal identification. Biometric technologies are the study of electronic systems that use individual characteristics such as fingerprint, voice, gait and facial comparison technologies to verify an individual's identity. With these considerations in mind, once the learning materials were developed they could then be used to supplement the course materials for both MOOC students and students who enrolled in the unit through a MOOC derivative or SPOC model. A SPOC is a Small Private Online Course and “these closed courses… integrate MOOC materials into an on-campus course, allowing local faculty to incorporate activities that enhance the learning experience for their students” (Hollands & Tirthali, 2014. p. 48).

From the nationally endorsed Certificate IV in Biometric Technologies qualification, the UoC deemed most suitable for the MOOC and SPOC was a 16 nominal hour unit titled CPPSEC2019A Monitor Biometric Equipment and Systems. This unit requires learners to monitor and respond to biometric equipment and systems, to understand biometric technologies for workplace implementation, to demonstrate awareness of issues related to confidentiality, privacy, and security, and to know the underlying concepts of biometrics for identification purposes. As this is quite a futuristic topic, it was thought it would entice a global audience. Once the innovation funding grant was approved, the CIT MOOC was able to be realised. As the MOOC was based on the unit Monitor Biometric Equipment and Systems, the performance criteria, elements and skills and knowledge requirements assisted in shaping the learning approach, materials development and offered guidance on the formative assessment structures necessary for demonstrating competence. Furthermore, the conceptual ideas for the MOOC were based on a cMOOC design or Connectivist learning theory (Downes, 2010; Siemens, 2005) which values the educational principles of “autonomy, diversity, openness and interactivity” (Bell, 2010, p. 529). Exploration of MOOC platforms that were willing to host the course led CIT to the Canvas Network and, in conjunction with the Canvas instructional designers and CIT course developers, the “Biometric Technologies: Identification for the Future” was established.

By offering Biometric Technologies: Identification for the Future via the Canvas platform, the course could be used as a MOOC-delivery model to enable free international student enrolment and to broaden CIT’s learner base. Additionally, the course could be duplicated on Canvas and run as a separate private course or SPOC-delivery model, but the SPOC would only be accessible once the student had enrolled in the Monitor Biometric Equipment and Systems unit through CIT. Furthermore, SPOC students would be required to complete a summative assessment on CIT's eLearn platform to demonstrate competence, before being awarded the UoC. The online courses for this study would be sourced from other units in the Certificate IV in Biometric Technologies and offered through eLearn, CIT's online delivery platform. As fully online units they deliver web-based materials and practical activities using electronic textbooks, open education resources and dialogue via discussion boards, announcements and email (BIS, 2013).

1.4 Complexities of engagement and retention

Student engagement is often linked to the relationships between the learner and their involvement in the learning process. The literature has provided many definitions of student engagement. Krause and Coates (2008, p. 493) suggest that engagement is "the quality of effort students themselves devote to educationally purposeful activities that contribute directly to desired outcomes". Coates (2005, p. 26) advocates student engagement "is based on the premise that learning is influenced by how an individual participates in educationally purposeful activities". Downes (2012, p. 527) cites Stovall's (2003) definition which recommends "that engagement is defined by a combination of students' time on task and their willingness to participate in activities". These are in contrast with Gorky's (2014, p. 18) definition which proposes student retention is the "student judgement of success in studies completed" and the learner's "ongoing recommendations to others".

Retention is more difficult to characterise as it can be the process of the student continuing with the course until completion of a qualification or a cyclical process of the learner returning to the educational institution for further learning after previous course completions (Cotter, 2013). However, often it is a measurement calculated to determine the success rate of groups of students and “a critical, although blunt, indicator of the extent to which students are involved in higher education” (Coates, 2005, p. 30) as “only those learners who persevere with a course have a chance of reaping the intended educational benefits of the learning experience” (Hone & El Said, 2016, p. 158). This said we lack consistent metrics to measure MOOC retention. The conventional way is to compare the enrolment number with the number of students who complete the course, but this not appropriate for quantifying MOOC retention (Paton, Scanlan, & Fluck, 2018). Therefore, correctly identifying metrics that can quantify engagement and retention was an important part of this study.

1.5 Research context and methodology overview

The context for the research was to support educational delivery with a MOOC model that maximises student retention and fosters greater levels of learner engagement. Through the cyclical analysis of MOOCs, SPOCs and online delivered courses, this research aspires to expand current literature and to identify a best-practice MOOC model that enhances the VET learner’s experience.

The study commenced in July 2015 for online learners and the first MOOC and SPOC group commenced in September 2015. The three-year period of data collection concluded in June 2018 and evaluated learners from 11 MOOCs, 6 SPOCs, and 6 online delivered courses. Over the progress of the study, a total of 2963 learners enrolled in the MOOCs, with 543 of MOOC students consenting to participate in the study. A total of 98 SPOC learners enrolled in the unit Monitor Biometric Equipment and Systems, with 47 agreeing to participate in the study. Across the two online units, Principles of Biometric Technologies and Apply Forensic Digital Imaging Techniques, 177 learners enrolled and 93 provided study consent. Therefore, 683 consenting participants were evaluated overall.

A pragmatic approach was adopted for this research as it provided a mix of quantitative statistical measurements with qualitative data to build a full understanding of VET MOOC and online learners through an action case study research approach. The MOOC and SPOC quantitative and qualitative data were sourced from two surveys, namely the Welcome to Canvas Network and the User Experience survey, and further learner analytics were gathered from the Canvas platform. Both quantitative and qualitative data for online students were collected from the CIT Subject Evaluation, eLearn student analytics and CIT enrolment forms.

1.6 Thesis structure

The thesis comprises six chapters. This first chapter, Chapter 1, introduces the background to the study and defines engagement and retention as it applies to VET MOOC, SPOC, and online learners.

Chapter 2 reviews the empirical literature regarding engagement and retention for universities and VET organisations for MOOC and online learning principles that led to the research questions and research predictors. The systematic literature review examines the available literature to tease out the issues and strategies that were most effective in engaging and retaining learners.

Chapter 3 identifies the theoretical framework and the methodological approaches undertaken in the research. It provides an overview of MOOC, SPOC and online course delivery attributes, triangulation process and mixed method procedures for the data analysis. This is presented through a detailed discussion of the applied research methods. The issues surrounding the study such as validity, reliability, ethical concerns and limitations are also outlined in this chapter.

In Chapter 4, the research findings document the outcomes of the scientific method analysis and articulate the learners' perceptions of their learning experiences. It also outlines the outcomes from the action research phases and research predictor examinations. The findings are then presented in terms of the research questions.

Chapter 5, the discussion, reviews the research questions and the related findings. It then draws out the functional approaches and strategies to expound the VOOM model and relates it back to the systematic literature review in Chapter 2.

The final chapter, Chapter 6, presents the conclusions as themes discussed in terms of each research question. The limitations of the study and future directions for research are also suggested. Then the research draws together a model that provides a detailed picture of VET learners and how best to engage and retain them in technology-rich online courses. The 12 recommendations may prove to be useful to both VET and other educational organisations contemplating better MOOC delivery or improvement of their online delivery practices.

2 LITERATURE REVIEW

This literature review chapter excluding 2.12 Literature Review Summary was previously published as an academic manuscript as follows: Paton, R., Fluck, A., & Scanlan, J. (2018, October). Engagement and retention in VET MOOCs and online courses: A systematic review of literature from 2013 to 2017. *Computers & Education*, *125,* 191–201.

2.1 Abstract

Building stronger structures that encourage deeper levels of learner engagement and retention in Massive Open Online Courses (MOOCs) is of significant interest to teachers of Vocational Education and Training (VET). Previous literature on MOOCs is predominately occupied with university-sector developments and alternative educational contexts such as VET are neglected. This systematic review of the literature published between 2013 and 2017 evaluated learner engagement and retention in university MOOCs and VET online courses to identify functional approaches that could be implemented into VET MOOCs. Ten databases were searched, eliciting 1950 papers, which were then screened. Data from 30 university MOOCs and eight VET online delivery articles that met the inclusion and quality assurance criteria were analysed. Four key themes and 11 component categories emerged repeatedly across the literature. Analysis revealed six functional approaches relevant to VET MOOCs. The findings suggested that coupling these functional approaches into VET MOOCs can improve learner retention and promote engagement. The implications for practice and further research are presented.

2.2 Introduction

Massive Open Online Courses (MOOCs) stimulated worldwide enthusiasm for an educational model that was believed to have the potential to revolutionise educational delivery. Distance and online learning were the precursors to MOOC delivery and there are many parallels across these modes (Flexible Learning Advisory Group, 2013). In the absence of face-to-face encounters, content is disseminated through quality instructional design, learners' competence is verified using innovative assessment instruments, and committed instructors facilitate peer collaboration activities to build strong online learning communities (Bruff, Fisher, McEwen, & Smith, 2013; Campbell, Gibbs, Najafi, & Severinski, 2014). These are important components of stimulating learner curiosity and maintaining student interest. The focus in the literature on MOOC retention and engagement is predominantly on university-delivered courses (Green, Oswald, & Pomerantz, 2015; Hone & El Said, 2016) but it is important to consider MOOC engagement and retention strategies that go beyond university settings (Flexible Learning Advisory Group, 2013).

Vocational Education and Training (VET) is an important sector that uses competency-based learning approaches (OECD), 2014) and an educational focus that is designed to deliver industry knowledge and practical skills to perform a specific job role. Universities, on the other hand, offer academic education that explores theoretical and hypothetical concepts for critical thinking (Keating, 2008). Norton and Cakitaki (2016) consider the distinctions between vocational education and higher education and suggest that both sectors are attentive to the world of work, but it is the application of knowledge and skills that differ. Another point of difference is the learner's educational level on course entry. VET courses typically have no or low-level entry requirements whereas universities require the completion of year 12 and an academic achievement score that meets the intellectual and competitive demands of each course. VET courses also have a relatively short timeframe with most qualifications completed in three to 24 months of full-time study. For universities, the course length is considerably longer and it can take the learner three to four years of full-time study to finish. Paton, Scanlan, and Fluck (2018), in their detailed study of MOOCs offered by Australian universities, international universities and VET providers, found a significant difference between the proportions of learners that completed MOOC courses for each educational context. The findings indicated that 35% of VET learners completed their courses as opposed to 29% for Australian universities and 28% for transnational universities. The variations in the delivery outcomes, entry requirements, course length and VET MOOC learner completions imply that that learners are receiving different educational experiences and, as such, should be examined as separate entities. However, as there is lack of empirical studies referencing VET MOOC strategies and, as VET and universities both reside in postsecondary education, examining the engagement and retention approaches from university MOOCs and VET online courses may provide utility for VET MOOCs.

This study was a systematic review of academic literature published from 2013 to 2017 and critically analysed university MOOCs and VET online courses for functional approaches that encouraged better engagement and retention of learners. This research represents the first efforts to review the literature on MOOC learner engagement and retention from a VET perspective.

2.3 Research methodology

The investigation of literature on learner engagement and retention in VET MOOCs and VET online courses was completed in two stages. The initial search evaluated VET MOOC literature and the second analysed VET online course research. The strategy identified for the systematic literature review is grounded in Zhang, Babar, and Tell's (2011) five-step methodical approach as follows: (1) Identify venues and engines, (2) Establish quasi-gold standard, (3) Define or elicit search criteria, (4) Conduct automated search, and (5) Evaluate search performance.

2.3.1 Identify venues and engines

The 10 databases identified for the preliminary search were: Academic Search Ultimate, EBSCO Information Services, IEEE Xplore Digital Library, ProQuest Research Library, Scopus, A+Education, Australian Education Index, ERIC, PsycINFO, and Web of Science. Initially, the five multidisciplinary databases were examined. These databases were selected as they provided a broad range of journal articles and conference papers relevant to university MOOCs and VET online courses. The selection of databases was guided by the works of Jacoby (2014); Khalil and Ebner (2014); Schwendimann, De Wever, Hamalainen, and Cattaneo (2018); and Veletsianos and Shepherdson (2016). Then, to gather more detail, social science databases were manually searched to refine the literature selection. This second manual search was conducted for articles in education specialist journals not indexed by the multidisciplinary databases or previously identified through the other database searches. The social science databases searched were: International Review of Research in Open and Distributed Learning; Global Education Review; Journal of Open, Flexible and Distance Learning; and Journal of Online Learning and Teaching. A third search used the Google Scholar engine to conduct a thorough hunt for additional articles for possible inclusion in this paper.

2.3.2 Establish quasi-gold standard

The relevant journals found by the searches were then subjected to critical appraisal through using ReLIANT (Koufogiannakis, Booth, & Brettle, 2006). The ReLIANT framework was identified as the most suitable from among several other tools as ReLIANT has a specific emphasis on the critical evaluation of education and training literature. The ReLIANT framework also provided the research with quality assurance and objectivity by guiding the systematic appraisal of research, focusing on four aspects of each study: quality of the study, instructional framework, study outcomes, and relevance to professional practice. This tool has been used numerous times (see for example Booth, 2007; Lipu, Williamson, & Lloyd, 2007; Thomas, 2013) although some limitations have been noted such as a lack of metrics for decision making, ethical matters not incorporated (Thomas, 2013) and the exclusion of information literacy practices (Lipu et al., 2007) from the original framework. To further the credibility of this research, the modified framework that encompassed 43 questions was applied. Thomas (2013) established a grading system that could be used with the framework to indicate the quality of a paper. Each question is scored 1 if the article meets the criteria. Then a percentage score for each theme was derived and an overall score across all six themes was calculated. Articles that attain >50% in each theme and >75% overall are considered “well conducted and reported” and assigned a Grade A rating. Other grades can be provided. However, for this research, only Grade A articles were considered. For further academic robustness and as an additional quality measure, the Grade A rating was bumped up to Grade A+ for articles gauged >60% in each theme and >84% overall.

The journal quartile ranking for each resultant article was identified from the 2016 SCImago Journal Rank (SJR). As quartile 1 (Q1) journals are considered highly influential and classified in the top 25% for the distribution of quality academic prose, the corpus for this systematic literature review should contain at least 25% of articles from Q1 journals to maintain quality coverage.

2.3.3 Define or elicit search criteria

The search boundaries from January 2013–August 2017 (when the research concluded) were selected as other published reviews on MOOCs already provided systematic coverage of the literature between 2008 and 2013 (see for example Jacoby, 2014; Khalil & Ebner, 2014). It should be noted that none of these studies specifically concentrated on VET. A publication by Veletsianos and Shepherdson (2016) provided a systematic review for MOOCs from 2013 to 2015; however, it contained limited discussion on retention aspects and concluded that a further focus on literature that concentrates on learner completion and retention in MOOCs was desirable.

As the focus of the study reported here concentrates on VET engagement attributes in both MOOCs and online courses, two separate examinations were conducted using search terms which correspond to these three key elements, as illustrated in Table 1. The search terms for this paper were guided by the research conducted by BIS (2013), Schwendimann et al. (2018) and Veletsianos and Shepherdson (2016).

Table 1. *Three-level keyword search criteria*

Keyword	MOOC	Online
1	MOOC (as an abbreviation) OR Massive Open Online Course AND	online delivery OR online learning OR distance learning OR distance education OR distance OR e-Learning AND
2	learner retention OR retention OR learner engagement OR engagement AND	learner retention OR retention OR learner engagement OR engagement AND
3	VET (as an abbreviation) OR vocational in combination with education or training (or both)	VET (as an abbreviation) OR vocational in combination with education or training (or both)

2.3.4 Conduct automated searches

The three-keyword search of the 10 academic databases for MOOC engagement and retention in VET identified 13 articles. A further 146 articles were found for online engagement and retention in VET. As only a limited number of articles were identified from the MOOC three-keyword search, the results from the two-keyword search, which identified 431 articles, were reviewed. The MOOC articles from the two-keyword search were more suited to the systematic review, with engagement and retention concepts identified from the literature more readily transferable to VET MOOCs. As a consequence of the utility of the papers identified in this way, the two-keyword search terms were applied to the remaining literature investigations for MOOC, although the three-keyword search was still deemed appropriate for the VET online searches.

A second search using the same two keywords for MOOC and three keywords for online was conducted on education specialist journals with peer-reviewed studies. The MOOC journal search resulted in 115 journal articles being identified and 46 journal articles when online was the search focus. The third search was conducted using the Google Scholar search engine (8 August 2017) with 719 articles identified for the MOOC search and 493 articles located for the online search.

As a result of the automated MOOC searches, 1265 articles were identified: 431 from databases, 115 from education specialist journals and 719 from the Google Scholar search. The online searches uncovered 685 articles: 146 from databases, 46 from education specialist journals and 493 from Google Scholar.

2.3.5 Evaluate search performance

An examination of the 1950 papers was then conducted for empirical data relevant to the interests of this inquiry. A detailed investigation of the titles and abstracts were undertaken with each paper assessed against the inclusion criteria as follows:

- Articles peer-reviewed
- Articles published between January 2013 and August 2017
- Articles published in English
- Articles including engagement and retention outcomes for MOOCs
- Articles including engagement and retention outcomes for VET online courses
- Articles including adult learners

After this process and the removal of duplicate articles, 325 articles were deemed suitable for ongoing evaluation. For quality assurance, these articles were then blind reviewed by one of the authors for a second time to ensure consensus with the inclusion criteria. Then a further screening of the 325 articles for inclusion or exclusion, using the ReLIANT framework, was undertaken with eligibility based on:

- Articles ranked at Grade A+ after critical appraisal against the ReLIANT framework.

The ReLIANT appraisal, after the second blind review, identified: 34 journal articles and four refereed conference papers as outlined in Figure 2, with 287 articles rejected as they did not meet the stringent requirements of the ReLIANT examination. All reasons for exclusion were documented and only the highest quality papers were integrated into the systematic literature review.

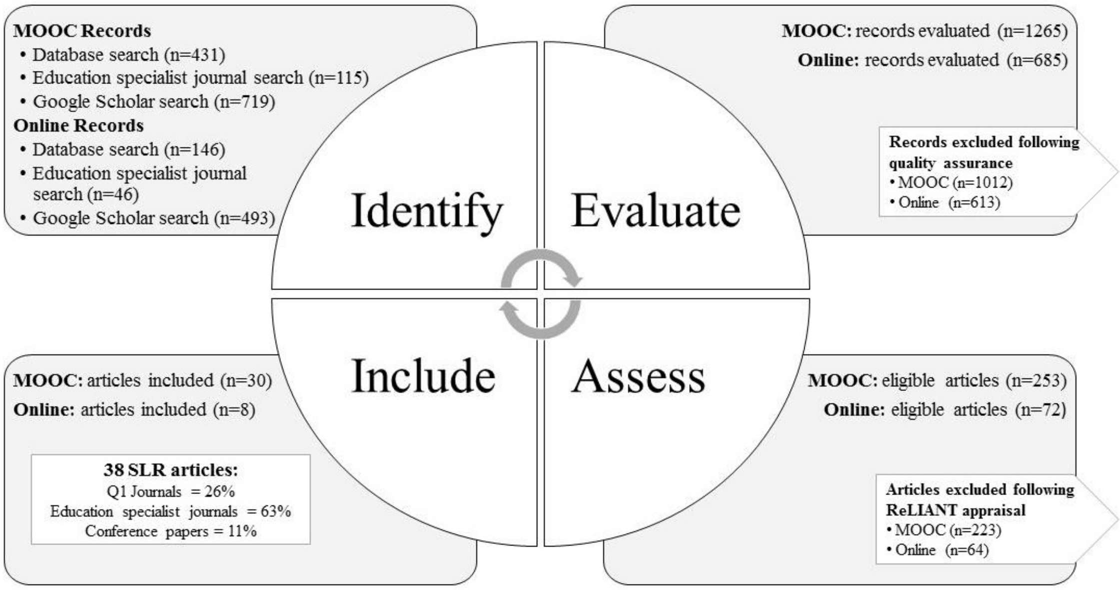


Figure 2. Evaluation of search performance.

The SJR and the number of resultant papers for MOOC and VET online course were then calculated. Q1 journal articles comprised 26% of all journal articles as established by the quasi-gold standard and these results are presented in Table 2. The studies included in this review are indicated in Appendix A.

A systematic review of each journal article and conference paper excluding references was undertaken using Text Analyser (available from online-utility.org/text/analyzer.jsp). The Text Analyser online content analysis tool was used to determine the underlying meaning and connections between sources (see for example Arumugam, Thangaraj, & Sasirekha, 2011; Garbett, 2016; Klijunaite & Nauseda, 2015). The underlying themes and categories were extracted from the occurrences of word frequencies for the top phrases containing six, seven and eight words. The information from each journal was then recorded in Microsoft Excel for coding and tallying of data (Klijunaite & Nauseda, 2015).

Table 2. *Resultant articles and SCImago quartile indicator*

Journal Title	**SJR**	**MOOC**	**Online**
American Educational Research Journal	Q1	1	0
British Journal of Educational Technology	Q1	3	1
Computers & Education	Q1	2	0
Educational Researcher	Q1	1	0
Educause Review Online	*	1	0
Electronic Journal of e-Learning	Q2	1	0
International Journal of Continuing Education & Lifelong Learning	*	0	1
Journal of Asynchronous Learning Network	Q3	0	1
Journal of Educational Technology & Society	*	0	1
Journal of Higher Education	Q1	2	0
Journal of Online Learning and Teaching	*	4	0
Journal of Open, Flexible and Distance Learning	*	1	1
Journal of Pedagogy	Q3	0	1
Scientific Research Journal	*	0	1
The International Review of Research in Open and Distributed Learning	*	10	1
Refereed conference papers	*	4	0
Total		30	8

* SJR not available

2.4 Results

The thorough inspection of the content and context frequencies of the 38 articles found four themes and 11 component categories which were significant for learners studying in MOOCs or VET online courses. Each paper was then carefully considered to determine if the themes and component categories were apparent. The proportion of articles that addressed each component category was calculated as displayed in Table 3.

Table 3. *Themes and categories from literature analysis*

Themes	Component categories*
Student perceptions of MOOCs	Learner's sense of community 74%
	Certification 39%
	Free vs fees debate 16%
Engagement and retention factors	Instructor commitment 74%
	Patterns of participation 34%
	Time zone variances 18%
	Content release 16%
Aspects promoting student retention	Instructional course design 92%
	MOOC topologies 37%
Student engagement relationships	Assessment construction 87%
	Prerequisites 24%

* Proportion of articles addressing each component category

2.4.1 Student perceptions of MOOCs

Student perceptions are a critical component in understanding engagement and retention attributes in MOOCs. This systematic review identified that fostering a learner's sense of community by developing strong student networks (Barak, Watted, & Haick, 2016) stimulates knowledge transference and improves learner retention. In addition, the perception that a certificate will be gained on course completion provides additional motivation for learners in MOOCs (Evans, Baker, & Dee, 2016; Green et al., 2015) and e-Learning courses (Baxter & Haycock, 2014) to complete. Entering a free MOOC which ends up being only partially free, has a negative effect on student completions, although educational affordability was not considered a strong inhibitor (Dillahunt, Wang, & Teasley, 2014).

2.4.2 Learner's sense of community

Discussion forums provided students with the opportunity to share and solve problems (Kellogg, Booth, & Oliver, 2014); however, active participation was limited, with learner time restrictions identified as the cause (Bruff et al., 2013). Baxter and Haycock (2014) reported that over 48% of students exploited the discussion forum as an academic learning tool. Campbell et al. (2014) found online MOOC forums were an important social structure that cultivates learner collaboration, with an average of 43% viewing discussion threads. Conversely, the number of learners who actually posted to the forum was as low as 13%. Kellogg et al. (2014), through interaction analysis modelling of 887 discussion posts, identified that more than half of the discussions contained knowledge sharing and mediated conversations, but rarely moved into the cognitive application of shared learning.

Yates, Brindley-Richards, and Thistoll (2014) showed that a major contributor to learner isolation was poor course design and this is an unfortunate outcome of MOOC pedagogy. Feelings of isolation can be reduced if consideration is given to the design of the social interaction tools being utilised. Maintaining good quality communication platforms (Barak et al., 2016) and electronic media sites (Hew, 2014) to enable shared information nurtures a sense of inclusion (Veletsianos, Collier, & Schneider, 2015) and fosters social interactions (Kellogg et al., 2014).

2.4.3 Certification

Generally, the certification of course achievement from a MOOC does not add any value except in providing personal or professional self-development opportunities (Radford et al., 2014). Dillahunt et al. (2014) found a significant difference in the proportion of "finishers" between those who enrolled in a course that offers a certificate (36.6%) and those in a course that did not offer such a certificate (19.2%). From a learners' perspective, receiving a certificate on MOOC completion offers more incentive to achieve the course requirements, and pathways that lead to formal recognition or course credits also entice learners to successfully finish (Green et al., 2015; Hone & El Said, 2016).

2.4.4 Free vs fees debate

A clear incentive for learners to enrol in MOOCs is attributed to the lack of fees, with hidden costs a contributor to learner withdrawal (Impey, Wenger, & Austin, 2015). Although the model is "free", there are many courses that contain unforeseen fees (Impey et al., 2015) such as tutor assistance and expenses associated with purchasing textbooks. Some institutions also offer students the option to pay for formal certification by charging a nominal fee for exam modules (Bali, 2014; Hew, 2014). This restricts the open nature of a MOOC and can have a flow-on effect of the withdrawal of learners.

2.4.5 Summary of student perceptions

Given the factors identified from university MOOCs and VET online courses, it seems worthwhile to conduct an organised study to evaluate students' perceptions of the effectiveness of discussions, certification and free vs fees on learner retention specifically for VET MOOCs. Consequently, research is urgently needed into VET students' perceptions of MOOC learning.

2.5 Student engagement and retention factors

Gorky (2014, p. 18) defined student retention as "student judgement of success in studies completed" and ongoing "recommendations to others". These definitions move the retention focus away from external learning barriers which prevent learners from engaging and from completion statistics which are the usual form of retention measurement (Jordan, 2014) to a learner-centred judgement as a determinant of retention. Understanding what stimulates students to progress through a course that is free and where the financial pressures often associated with learning are absent should increase learner engagement and promote better retention. Only 14% of learners completed the first MOOC offered by Stanford University in 2011 and subsequent MOOCs have also been plagued with low retention rates, with average student completions of 12% (Perna et al., 2014). Some courses have reported retention to be as low as 6.5% (Jordan, 2014). By contrast, Dillahunt et al. (2014) found that over 36% of learners completed MOOCs that awarded a certificate of completion. Student engagement and retention literature identified instructor commitment as a main contributing factor, although learner patterns of participation, time zone variances, and content release strategies were also acknowledged as important influences.

2.5.1 Instructor commitment

Instructor involvement enhances learner retention (Hew, 2014) and prompt contextualised communication improves learner satisfaction (Pilli & Admiraal, 2017). Instructor behaviour can have a negative impact on engagement as poor teacher interactions discourage learners (Hone & El Said, 2016). It can be time-consuming to provide sustainable interactions with large student numbers, in different time zones, and through asynchronous learning tools. Timely feedback in a MOOC is difficult for the teacher to sustain and this lack of responsiveness to a learners uncertainty can impede the learner’s ability to progress (Khalil & Ebner, 2013).

2.5.2 Patterns of participation

There is some dissent about what denotes learner participation in MOOCs. The selection of appropriate metrics to measure MOOC participation requires further research (Admiraal, Huisman, & Pilli, 2015). Whitmer, Scholrring, James, and Miley (2015) quantify learner progression throughout MOOC activities into four discrete learner classifications: persisting, lurking, declining and disengaged. Veletsianos et al. (2015) surmised that a much broader range of categories exists, with additional classes such as no-shows, latecomers, and engaged participants also acknowledged. Conversely, Barak et al. (2016) identified five types of students from their analysis of motivational goals: networkers, problem-solvers, benefactors, innovation-seekers, and complementary-learners. Students who possess these goals are more likely to succeed. The literature search did not reveal any specific articles that documented learner participation patterns for VET online courses; therefore, the relationship between these measures and VET MOOC learners cannot be established.

2.5.3 Time zone variances

Studies into increasing student retention and improving learner engagement identified several strategies that can be implemented when dealing with time zone disparities. Bruff et al. (2013) found that pacing and accommodating students through alternative timetabling are ways to improve student retention. As open courses have the potential to reach enormous class sizes, trying to adopt this strategy could be seen as nearly impossible when students are geographically dispersed (Fournier, Kop, & Durand, 2014). Although this is a complication for instructors, the opportunities for global interactions among learners through asynchronous and synchronous communication for students located in similar time zones can be a positive factor in retaining them (Bali, 2014).

2.5.4 Content release

Bruff et al. (2013) found that students have different preferences, particularly in the way content is released, with some preferring week-by-week release of subject matter and others wanting all the content to be available from the time of course commencement. Despite this, Perna et al. (2014) identified a few learners from their study of 541,576 starters who randomly explored the course materials. In most instances, learners went straight to the last lecture before systematically working from the beginning.

2.5.5 Summary of student engagement and retention factors

Instructor commitment invigorates learning, stimulates ongoing course progression, and was noted as a key strategy of student retention in MOOCs and VET online courses. Participation patterns, course flexibility and the accommodation of time differences are also strong contributors to how the learner engages with the course materials, but these can have a negative effect on instructor workload and ability to provide timely support. Considering these and the importance of the associated dynamics, further research could be undertaken to identify the factors in student engagement and retention for VET MOOCs.

2.6 Aspects promoting student retention

The way MOOCs and online courses are designed has a considerable effect on student retention. De Freitas, Morgan, and Gibson (2015) investigated the retention of students studying a MOOC through the Open Universities Australia delivery platform. The course “Astronomy” was selected for this research as it was seen to be a course that was enjoyable and popular with learners of all ages. The methodology for the study was inductive research with data evaluated from 369 reviews and 102 written remarks. The findings suggested that there was a steady drop of 5% at the start of the course, but this eased by the final module. Students who maintained their participation in the early modules largely went on to complete the entire course.

Milligan, Littlejohn, and Hood (2016) compared two qualitative studies with learners completing MOOCs to determine the learning strategies that benefit high- and low-performing learners. The first study registered 50,000 MOOC learners from across 197 countries and the second enrolled 22,000 students from 168 countries. A subset of participants from each study was invited to complete a survey and interview. The results identified three aspects that contributed to motivational differences in learners and which were beneficial for retention. Goal-setting improved students’ professional abilities and enabled career development opportunities, with learner motivation based on the desire to increase work capabilities. Self-efficacy among most MOOC participants was evident as personal interest and topic knowledge played a major part in the decision by these students to commence a MOOC. Third, the learning environment provided a variety of learning stimuli, which was meaningful for ongoing student persistence. While this study provided some important insights into the motivational variables that contribute to MOOC learners, their samples were limited to two MOOCs with content that was knowledge rich. Since VET MOOC students require learning that revolves around the practical mastery of skills, further investigation of these concepts in practice for VET MOOCs is needed.

2.6.1 Instructional course design

MOOCs are an emerging learning opportunity that has evolved from open learning and distance education philosophies. This new wave of educational delivery is highly focused on innovative technologies delivering course materials. However, Chen's (2014) study reminds developers that there are still many challenges to consider when designing a sustainable MOOC.

Spyropoulou, Pierrakeas, and Kameas (2014) analysed the structure, configuration and general characteristics of MOOCs from six learning platforms to determine quality factors. All courses were facilitated by instructors and the duration of each course varied, as did the mixture of learning activities and assessment tasks. The results established three key quality-sensitive areas as best practice traits: curriculum development, educational materials, and MOOC implementation.

Gamage, Fernando, and Perera (2014) used grounded theory to analyse data collected from 121 students over 2 years to investigate the students' perspectives of e-Learning. Their detailed investigation using Principal Component Analysis (PCA) classified 10 key areas that e-Learning students identified as important: interactivity, collaboration, motivation, networking opportunities, pedagogy, content/material, assessment, usability, technology and support for learners. Many of these attributes were also modelled in university-developed MOOCs.

2.6.2 MOOC topologies

Topology or the “study of the way in which constituent parts are interrelated or arranged” (English Oxford Dictionaries, 2019), in conjunction with the overall MOOC’s design establishes the underlying pedagogy for the rest of the course. There are two main types of MOOC that are commonly discussed in the literature: xMOOCs (de Freitas et al., 2015) and cMOOCs (Admiraal et al., 2015; Bali, 2014).

xMOOCs reflect theories such as instructivism (Jordan, 2014) and cognitive-behaviourism (Admiraal et al., 2015; Bali, 2014), but recently Virtual Reality (VR) has been offered as an xMOOC alternative. VR allows the student, though computer-generated discovery learning, to gain knowledge of real-life applications through virtual scenarios (Onyesolu, Nwasor, Ositanwosu, & Iwegbuna, 2013).

cMOOCs are based on the connectivism learning theory (Admiraal et al., 2015; Bali, 2014). With connectivism, the emphasis is on learners making connections to knowledge and skills through social learning experiences (Bali, 2014). Previous theories of behaviourism, cognitivism, and constructivism have worked for many learning environments but cannot take into account some of the unique affordances MOOCs offer (Fournier et al., 2014; Hew, 2014). Connectivism as a contemporary theory is becoming a more accepted ideology, with the recognition that networks have the potential to promote or discourage students from participating in meaningful and stimulating discussions. To effectively nurture these networks, it is necessary for strong connections to be built through learner interactions, even when at times these interactions function across multiple levels (Wang & Baker, 2015).

2.6.3 Summary of aspects promoting student retention

The concepts surrounding instructional design and MOOC pedagogy are influential in learner retention. For competency-based learning models, the design structures of university MOOCs may not be adequate to meet VET requirements. VET online courses are not necessarily suitable either as they have smaller student numbers and less significant geographical complications. Interactivity and networking, combined with quality educational theories and course design, are valuable factors in promoting retention and therefore it is pertinent to explore them in greater detail. Hence further empirical research should be conducted to expose further aspects of interaction and networking that promote student retention in VET MOOCs and VET online environments.

2.7 Student engagement relationships

Student engagement can be disrupted once the learner completes his or her first assessment; although attention to the learner's prerequisite skills through detailed pre-enrolment information can alleviate some of the factors associated with student drop-out early in the course. Hew (2014) identified factors that influence student engagement in online courses and MOOCs. He analysed data from 965 course participants. Of these, 908 participants had completed at least one previous MOOC, 53 were currently undertaking their first MOOC and 14 had dropped out entirely. A qualitative multiple-case study that collected and reviewed data from student comments in the publicly available forum "coursetalk" were investigated. The courses that students ranked the highest, and those that had the most reviews within a particular discipline, were considered more appealing to the learner with the subjectivity of this assumption acknowledged by the author. Nevertheless, the outcomes of this study indicated student engagement was improved by quality course resources and reliable educational pedagogy.

2.7.1 Assessment construction

MOOCs require testing arrangements that effectively measure student competence. Ineffective assessments that do not align with the course objectives, and the task of marking large numbers of written assessments, are ongoing challenges for MOOC developers (Admiraal et al., 2015; Chen, 2014; Yousef, Chatti, Schroeder, & Wosnitza, 2015). The common assessment instruments identified across MOOC literature included multiple choice self-marking quizzes, electronic tasks, written assignments that are peer or teacher assessed and final exams which can be self-marking, peer or teacher assessed (Chen, 2014). Although the design of assessments that enhance course retention and promote deeper understanding is demanding, it is desirable as learners acquire long-term gains as a result (Admiraal et al., 2015; Bali, 2014). The availability of effective online assessment choices is limited and concerns surrounding cheating methods employed by tech-savvy learners are particularly difficult to alleviate (Chen, 2014).

Jordan (2015) evaluated 221 courses from Coursera and Open2Study. A regression analysis was used to investigate the association between student completion and the type of assessment. Peer-graded assessments were identified to be negatively associated with learner completion and the author provided a warning against using peer-grading for essays in MOOCs. The preference was for multiple choice quizzes which were developed to meet the curriculum requirements of the course. In contrast to this, Pilli and Admiraal (2017) encouraged peer and self-assessment as a formative testing tool with rubrics and information to guide the learner. Another formative assessment practice, that moves away from the typical tools employed in online assessment, are Stealth assessment strategies. These are electronically embedded into the course design and are used to discreetly and continuously measure the learners' performance as they interact with the course activities (Spector et al., 2016).

2.7.2 Prerequisites

The lack of prerequisite skills has important implications for learning relevance and on student drop-out (Evans et al., 2016; Khalil & Ebner, 2014). Although MOOCs do not enforce prerequisites before enrolment, the cognitive level of courses often means students do not have the background skills to understand the course information and this can lead to feelings of inadequacy (Whitmer, Scholrring, James, et al., 2015; Wladis, Wladis, & Hachey, 2014; Yates et al., 2014). Although most people have adequate computer skills, digital reading proficiency and notetaking of print-based resources are often problematic for online students (Baxter & Haycock, 2014; Safford & Stinton, 2016; Veletsianos et al., 2015). Lack of technical support when glitches occurred also produced difficulties (Safford & Stinton, 2016). These, combined with slow typing speeds, are documented reasons why students withdraw. In contrast, Engle, Mankoff, and Carbrey (2015) found that learners who had a background in the topic were more likely to complete the course and they demonstrated improved course performance.

2.7.3 Summary of student engagement relationships

VET MOOC learners are not traditional students; therefore, it is necessary to provide significant support structures to encourage learner engagement and reduce learner distractions. Constructing assessments which promote engagement and measure competence can be confronting with limited assessment tools. It is also difficult to design courses with minimal prerequisites or to ensure underpinning knowledge is incorporated into the course design. These challenges warrant further investigation in a VET MOOC context and more work is needed to clarify the relationships between student engagement in VET MOOCs and VET online environments.

2.8 Summary

Investigations into the importance of identifying empirical discussions to better understand how courses offered by VET function in the MOOC space revealed no relevant literature. Nevertheless, university MOOCs and VET online courses provided insight into areas that could be implemented in VET MOOCs. The six functional approaches that promoted engagement and retention are good-quality instructional course design, well-developed assessment tasks aligned with course objectives, opportunities for learners to collaborate, instructor commitment to timely contextualised communication, certification for course achievement, and pathways to further study. Together these form a best practice framework for VET MOOCs. The mixture of these functional approaches and what specifically works best for VET MOOCs is still unknown. It would be useful to discover the design strategies that maximise student engagement and retention for VET MOOCs and to capitalise on these practices in a functioning VET MOOC.

2.9 Discussion

The analysis of the articles in this review found no specific literature on VET MOOCs. Several important factors that promoted learner engagement and retention in university MOOCs and VET online courses were identified. The similarities between these learning modes provided strategies that may be transferable to VET MOOCs.

VET learning models are distinctively different from those found in universities as VET education revolves around learners gaining practical skills with less intensive knowledge and assessment outcomes (Keating, 2008; Paton, Scanlan, et al., 2018). Although both VET and universities operate in tertiary education, the underpinning concepts are different, particularly in their learning approach, course entry requirements and, in many instances, the learner's qualification level on entry. As there is limited literature on VET MOOCs, the focus must be placed on educational providers such as universities and VET online learning models for this empirical knowledge.

Student perception is a critical component when understanding learner engagement and retention attributes in VET MOOCs. For practically orientated learners, the knowledge shared through discussion exchanges should be relatively straightforward, content orientated and require short responses to achieve increased learner contributions (Kellogg et al., 2014). As more students are inclined to view discussion threads than actually post (Campbell et al., 2014), consideration of non-compulsory forums in VET MOOCs are likely to reduce feelings of isolation (Yates et al., 2014) and foster stronger student networks (Barak et al., 2016). Additionally, providing a certificate of participation is a strong motivator for learners (Dillahunt et al., 2014) and although it is only symbolic of course completion (Radford et al., 2014), it is useful as evidence of ongoing professional development. MOOC certification also provides an acknowledgment that the learner has attained the formative skills to demonstrate competence. Learning pathways from a MOOC into a qualification can be a strong motivator for learners to complete the MOOC initially (Green et al., 2015; Hone & El Said, 2016), but it also provides successful learners with the opportunity to undertake further studies for career development (Milligan et al., 2016).

Student engagement and retention are reliant on the instructor nurturing the communication process and the way he or she interacts with participants (Hew, 2014; Pilli & Admiraal, 2017). Sustainable and meaningful communications can be complicated when learners are geographically widespread (Bali, 2014; Khalil & Ebner, 2013) and the ability to provide timely support, particularly for flexible course design approaches, requires teacher dedication. Expanding the opportunities for learners to connect with other participants by utilising both asynchronous and synchronous communication tools will reduce the teacher's workload and assist in further stimulating learner engagement in VET MOOCs.

Student retention is enhanced through good-quality instructional course design and this was seen to promote learner retention. Gamage et al. (2014) acknowledged 10 key quality concepts which enhance retention in e-Learning courses, with many of these attributes suitable for VET MOOC designs. The choice of MOOC pedagogy also has a strong influence on the course structure, but neither xMOOC nor cMOOC topologies in their entirety satisfy the VET requirements to deliver competency-based education. Whilst xMOOCs with VR learning are desirable applications for practical skill development as required by VET learners, the instructional design costs to produce such innovative learning tools are generally out of reach for most VET providers. Despite this, new theories are continually appearing as improved technological innovations and more analytical data become available.

Building student engagement relationships with large numbers of learners, assessing them appropriately with limited assessment choices (Yousef et al., 2015) and maintaining a reasonable handle on cheating (Chen, 2014) are challenges for MOOCs and online courses. It is important to design practical assessment tasks that enable VET learners to demonstrate competence while considering learner deficiencies such as students who lack the prerequisite skills, slow typing speeds or inadequate technical abilities (Baxter & Haycock, 2014; Safford & Stinton, 2016; Veletsianos et al., 2015). Well-designed assessment instruments that focus on work-based proficiencies are achievable through multiple choice self-marking quizzes, assessed electronic tasks and, to some degree, written assignments although these take considerable teacher time to mark. The use of peer-assessments are discouraged as it reduced learner engagement (Jordan, 2015), but as VET is quite accustomed to employing rubric-styled assessments, this mode of testing can be used to build stronger learning communities and reduce the instructor’s marking load (Pilli & Admiraal, 2017). Innovative assessment practices such as Stealth (Spector et al., 2016) are particularly exciting as these strategies further encourage engagement by alleviating the stresses encountered by learners completing assessments. However, well-constructed formative assessment tasks can also assist in reducing students’ assessment concerns. These strategies, combined with problem-centric and active learning principles, are desirable qualities for MOOCs developed by VET.

This study classified four themes and 11 component categories that influenced engagement and retention of learners in university MOOCs and VET online courses (Table 3). Further analysis identified six functional approaches that promoted engagement and retention, these are:

- Good-quality instructional course design
- Well-developed assessment tasks aligned with course objectives
- Opportunities for learners to collaborate
- Instructor commitment to timely contextualised communication
- Certification for course achievement
- Pathways to further study

In essence, the functional approaches could be transferable to future VET MOOC models. However, Lincoln and Guba (1985) recommend it is “not the naturalist’s task to provide an index of transferability, it is his or her responsibility to provide the database that makes transferability judgements possible on the part of potential appliers” (p. 316). Therefore, the findings of this research provided strategies that could be applicable for replication but, in practice, the application still requires further empirical substantiation.

2.10 Limitations

This systematic literature review has identified implications for promoting engagement and retention in VET MOOCs. The transferability of the findings from university MOOCs and VET online courses into VET MOOCs may be difficult, as all three learning modes have unique nuances that could mean that none of the suggested methods would be suitable. It remains to be seen how different these learning environments are when the same diverse learners and learning tools are being used to educate for free. Another limitation is the timeframe for the review, as 3.5 years could be considered rather narrow. The search boundary was selected as existing systematic literature reviews have already provided extensive coverage of engagement and retention in university MOOCs from 2008 to 2013 (see for example Jacoby, 2014; Khalil & Ebner, 2014). As this research wanted to extend current empirical knowledge, the period from January 2013 until the research concluded in August 2017 was nominated.

2.11 Conclusions and future directions

This review provided a focus on MOOC design strategies appropriate for VET MOOCs. A number of insights were identified through the synthesis of the literature to enable the researchers to understand MOOC learner engagement and retention from the VET viewpoint. The six functional approaches that were proposed in the study and that may assist in better nurturing the VET learners' MOOC experiences are good-quality instructional course design, well-developed assessment tasks aligned with course objectives, opportunities for learners to collaborate, instructor commitment to timely contextualised communication, certification for course achievement, and pathways to further study.

Based on the findings, there are several suggestions for future research. First, an in-depth investigation is required into VET students' perceptions of MOOC learning to ascertain what motivates them to complete a course and identify learner persistence strategies. Second, it is suggested that the correlation between student engagement and retention factors for VET MOOCs be further examined. Third, there is a need for a study that could validate the aspects that promote student retention in VET MOOCs and VET online environments, to provide further guidance on how VET learners are best retained. Fourth, an examination is required of the relationships between students who engage in VET MOOCs and VET online environments, to isolate the learning attributes that are most conducive to improving VET learner engagement. Finally, an action research exploration of the most effective engagement and retention principles should be undertaken, and the emerging theoretical patterns documented as a best practice approach for replication in other VET MOOCs. These research questions have formed the basis of a larger research investigation, with the aim of generating an empirical understanding of the factors surrounding engagement and retention in VET MOOCs.

Given the extent of the connections made between the findings and existing literature, it can be argued that the outcomes of this study support the contextual factors of engagement and retention for learners completing MOOCs or VET online courses. The practical designs acquired from this study give further encouragement that improved student completions and enhanced learner engagement and retention are highly possible in MOOCs offered by VET.

2.12 Literature review summary

The systematic literature examination brought together 38 scholarly articles which identified four themes, 11 component categories (Table 3) and six functional approaches (Functional approaches) that promoted engagement and retention in university MOOCs and VET online courses. These are illustrated in the SLR (Systematic Literature Review) engagement and retention tree, in Figure 3.

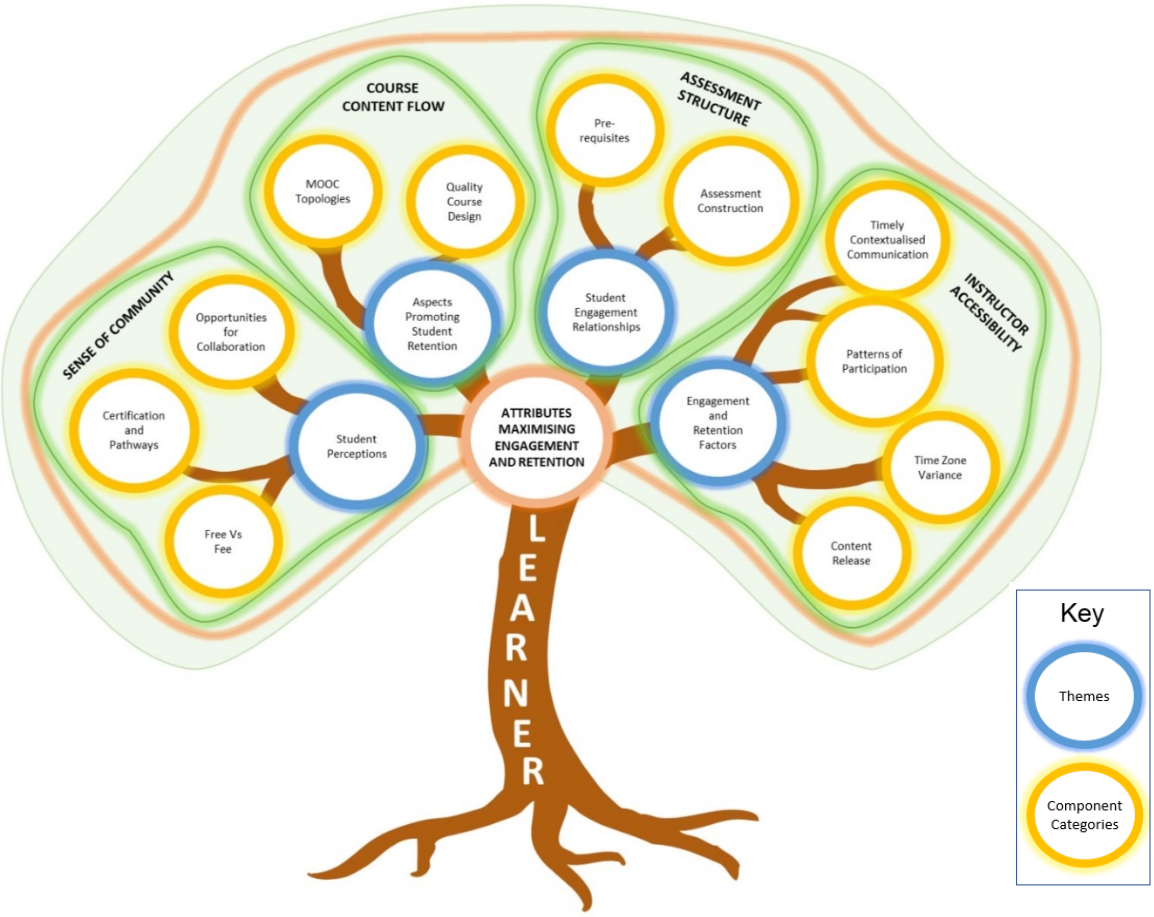


Figure 3. SLR engagement and retention tree.

The foundation attributes revealed by the literature review and SLR engagement and retention tree enabled the facilitation of five research questions and four action research predictors which formed the basis for the research.

Accordingly, the research questions outlined by the discussions, limitations and future directions central to exploring engagement and retention in VET MOOCs were identified as:

1. What are Vocational Education and Training (VET) students' perceptions of MOOC learning?
2. What are the factors identified in student engagement and retention for VET MOOCs?
3. What are the relationships between student retention in VET MOOCs, SPOCs, and online environments?
4. What are the relationships between student engagement in VET MOOCs, SPOCs, and online environments?
5. How effective is the evolutionary development of a best practice MOOC design in maximising student engagement and retention?

The continuous improvement mechanisms for ongoing analysis of VET technology-rich online learning also surfaced from the systematic review and tree. These formed the structure for the action research component with a cyclical evaluation of learner completions based on the four research predictors:

1. Sense of community
2. Course content flow
3. Assessment structure
4. Instructor accessibility

The synthesis of outcomes from the research question inquiries and predictor analysis findings strengthened understanding of learner retention in VET MOOCs. Additionally, a journey of action discovery could confirm the contextual factors and practical applications that promote VET learner engagement in fully online technology-rich learning models. The empirical data could then enhance the SLR engagement and retention tree into a best practice model constructed for digital learning excellence in VET MOOCs.

3 Research Methodology

3.1 Introduction

This chapter describes the research methodology and how the inquiry components of the study align with the theoretical framework. The study overview (Figure 1) presented the initial construct for the research. Then the research focused on a post-positivism epistemological philosophy (section 3.2.1) with the discussions grounded on the pragmatic paradigm (section 3.2.2), where knowledge and truth are attained from using the most suitable method practices for each inquiry question. The inductive and deductive approaches then support the underpinning theoretical position which is established on connectivism (section 3.2.3). In this chapter, the theoretical framework (section 3.2) is presented, followed by the research approach (section 3.3) and detailed procedures. The chapter then explores validity and reliability (section 3.4), ethical issues (section 3.5) and, finally, limitations (section 3.6).

This study, as previously outlined, explored learners enrolled in VET MOOCs, SPOCs, and online courses to gain a more detailed picture of the factors and relationships that contribute to, and impact on, learner engagement and retention. The action research process (section 3.3) triangulated data from learners across the three learning modes, MOOCs (section 3.3.3), SPOCs (section 3.3.3), and online courses (section 3.3.4) and each other to gain a detailed understanding of how MOOC learners learn best and the strategies to keep them engaged.

The main aim of the study and the five research questions that guided the research are:

The aim of the study:

> To investigate learner engagement and retention in Vocational Education and Training (VET) MOOCs (Massive Open Online Courses), SPOCs (Small Private Online Courses), and courses delivered online.

Research questions:

1. What are Vocational Education and Training (VET) students' perceptions of MOOC learning?
2. What are the factors identified in student engagement and retention for VET MOOCs?
3. What are the relationships between student retention in VET MOOCs, SPOCs, and online environments?
4. What are the relationships between student engagement in VET MOOCs, SPOCs, and online environments?
5. How effective is the evolutionary development of a best practice MOOC design in maximising student engagement and retention?

3.2 Theoretical framework

The theoretical framework for this study was initially founded on a post-positivism epistemological philosophy leading into a pragmatic paradigm. This was followed by exploratory inductive and deductive reasoning which integrates connectivism theory to emphasise the effects technology has on learning. Then, using the research onion process, the study connected the research aims, questions and research strategy to provide a cohesive and strategic approach for the research design (Saunders, Lewis, & Thornhill, 2012). Existing studies that focused on engagement and retention have generally used a mixed research approach. Gasevic, Kovanovic, Joksimovic, and Siemens (2014) identified, from their analysis of 265 research proposals received by the Gates Foundation MOOC Research Initiative, that the largest proportion (42.3%) used a mixed methodology when compared to purely theoretical approaches (quantitative: 33.3%; qualitative: 24.4%).

The research process onion (Saunders et al., 2012) incorporates the significant considerations required for a complex research study. The eight layers consider the following: the philosophical position of the researcher, the paradigm for the study, the chosen research approach, the theoretical position, suitable research strategies, the research methods adopted, the timeline reviewed by the research, and the techniques used for data collection. In consideration of the research process onion and after reviewing the inquiry components for the research, it was ascertained utilising a pragmatic paradigm that incorporated connectivism theory (section 3.2.3) with an overarching post-positivism (section 3.2.1) position were pertinent for the study. This was corroborated by Veletsianos and Shepherdson's (2016) findings from their review of 81 empirical MOOC papers which concluded that the majority of papers used two (47%) theoretical approaches (the remaining percentages being one approach: 13.1%; three approaches: 28.4%; four approaches: 8.7%; five approaches: 2.7%).

Exploring the epistemological assumptions that resided in existing research papers was critical to understanding the relationships between layers for this study (Saunders et al., 2012). As each component informs the research, a systematic evaluation of research aims against each layer was employed to better facilitate the development of empirical knowledge and academic critique (Greene, Caracelli, & Graham, 1989). Powell (2001, p. 884) suggested that “to a pragmatist, the mandate of science is not to find truth or reality, the existence of which is perpetually in dispute but to facilitate human problem solving”. Therefore, this philosophy lends itself to the ontological position that truth is constantly changing and the epistemological reality that no one single approach can be used to acquire knowledge (Rorty, 1982). As there is no single methodological stance to guide a pragmatic research study, it was essential that this study be explicit about the reasons for using mixed methods and to define the relationships that exist between the inquiry components of research aims, questions, and hypothesis (Bryman, 2006; Greene et al., 1989). So by using the research process onion, the theoretical aspects for this study could be substantiated (Saunders et al., 2012).

The post-positivist stance (section 3.2.1) conducted in the study provided an explanation of observed behaviour through causal relationships (Morgan, 2014). The post-positivism researcher uses scientific constructs to build and predict social factors related to learners engaging in online learning environments (Creswell, 2014). Additionally, the pragmatic paradigm (section 3.2.2) was selected as it had commonalities with the research from Hew (2014), Littlejohn (2013) and Pilli and Admiraal (2017). In their studies, the philosophical assumptions were enriched through quantitative and qualitative analysis and the mixed comparisons provided a deeper understanding of MOOC engagement and retention outcomes in university learners. Accordingly, connectivism theory (section 3.2.3) informed the research through the perspective that there is no specific way for an educator to transfer knowledge in a digital environment, and engagement of individuals is the process that creates learning (Kop, 2011). Knowledge is seen as “too diverse and flows too rapidly to be held in the human mind” (Bell, 2010, p. 529) and with decentralised networks, the transference and building of knowledge are possible (Siemens, 2005). Acknowledging the importance of connectivism theory and gaining knowledge by knowing how and where students gain information rather than the individual’s capacity to recite subject matter (Sokolovskaya, 2015) were inherent considerations for the research. As such, the inclusion of connectivism theory (section 3.2.3) underpinning a pragmatic paradigm (section 3.2.2) and post-positivist (section 3.2.1) philosophical position, brought together in an action research model, assisted with a process of inquiry that actively seeks to address areas of concern and fosters “positive change within classrooms, schools, and communities” (Hine, 2013, p. 161). The layers of the theoretical framework for this study are shown in Figure 4.

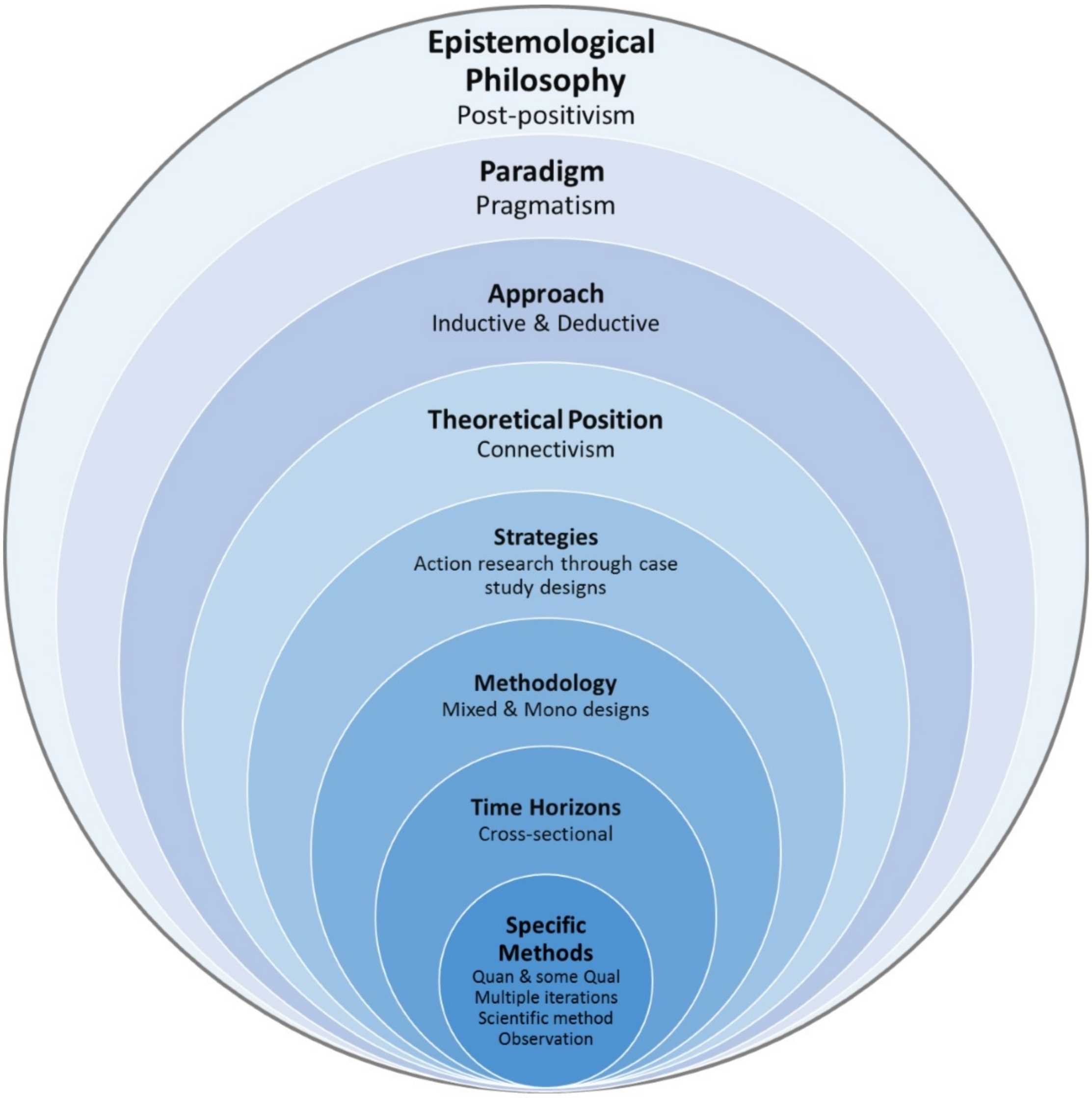


Figure 4. Saunders et al.'s (2012) research process onion, showing the theoretical perspectives, methodological practices and conceptual links in this study.

Each layer is discussed in further detail and the relationships between the epistemology, paradigm, approaches, theoretical position, research inquiry, purpose, and questions that overarch this study are outlined.

3.2.1 Post-positivism

A post-positivism epistemological philosophy couples scientific method with the traditional assumptions of research to analyse the behaviours and actions of individuals (Creswell, 2014). This broadens the scope of this research from a purely positivistic philosophy (Phillips & Burbules, 2000) to one that is reflective and acknowledges that research outcomes can be fallible (Johnson & Onwuegbuzie, 2004). A post-positivist reality is achieved by making, refining or abandoning claims and the main value of this paradigm is its objective nature (Creswell, 2009), as opposed to subjectivity that is noted in connectivism (section 3.2.3). A post-positivist position for this study was achieved by evaluating descriptive and causal evidence. This sculpted the researcher's knowledge through a systematic evaluation of learner progression across and between MOOCs, SPOCs, and online learning courses. Additionally, non-parametric testing after each course iteration to identify inferential relationships in learner engagement and retention was used to formulate empirical hypotheses for the study and so probability outcomes could be determined (Creswell, 2014).

It is acknowledged that post-positivism has inherent flaws and, according to Cohen, Manion, and Morrison (2007), care must be taken when using a post-positivist approach as it considers “life in measurable terms rather than inner experience” (p. 18). With the exclusion of individual experiences from the research process, a study is effectively concentrated in a subject–object stance and this fails to recognise the social science aspirations of measuring subjective–objective relations (Giddens, 1976). In contrast, this current study uses a pragmatic approach which combines post-positivist quantitative analysis with connectivist qualitative evaluations. Therefore, this research strategically combines paradigms so that the focus is shifted from a scientific inquiry towards a more sophisticated model that merges probability outcomes with metaphysical assumptions to obtain a clearer understanding of the research questions (Morgan, 2014).

3.2.2 Pragmatism

The pragmatic paradigm recognises that some research crosses between the two epistemological extremes of positivism and interpretivism. A positivist position is focused on objectivity and realism, with research formulated through hypothesis testing and quantitative data, while the interpretivist paradigm challenges the positivist doctrine as knowledge is created through a contextualised and social understanding of the individuals' view of the world. The use of qualitative methodologies for the interpretivist paradigm can also be subjective as the interpretation of lived experiences requires the participants and researchers to be more closely interlinked. The importance of the pragmatic approach to inquiry and the combination of theoretical practices aligned to the research context "creates its own world of research" (Morgan, 2014, p. 5). Therefore, the pragmatist research conducted in this study is not bound by a particular philosophy and a variety of perspectives were used by the researcher to objectively and realistically evaluate the inquiry questions.

Historical pragmatism originated during the mid-1800s with thinkers such as C. S. Peirce (1839–1914), William James (1842–1910) and John Dewey (1859–1952). They promoted that the discovery of truth resides in practical results and observable consequences. However, from 1930 to 1940 this paradigm became less prominent and slowly lost traction as alternative approaches such as post-positivist and critical theory surfaced (New World Encyclopedia contributors, 2015). From the early 1970s, Richard Rorty (1982) became a strong advocate of neo-pragmatism which revitalised this philosophical movement as the flexibility of a pragmatic paradigm enabled researchers to use multiple ways to find the knowledge of truth. Scholars such as Greene et al. (1989) and Bryman (2006) joined Rorty in recent years to promote the ontological and epistemological values of pragmatism through conceptual frameworks that complement and overlap theory and practice.

Rorty (1982) provided a pertinent warning in that pragmatism can be vague and confusing since each layer of the research may effectively use a combination of methodological approaches splayed across the positivist/interpretivist continuum. It is also acknowledged that the interactions of mixed method results are inherently more complex (Bryman, 2006).

3.2.3 Connectivism

Connectivism is a theory adapted to describe learning in the digital age (Siemens, 2005). Previous theories of behaviourism, interpretivism, and constructivism have worked for many learning environments. However, they cannot account for some of the unique distinctions offered by distance education. Connectivism was first considered as simply an observable phenomenon (Powell, 2001) and, with the advancement of electronic technologies, this theory could be implemented (Bell, 2010). Connectivism as a learning theory is a process of connected and specialised nodes which support diverse conversations conducted through non-human technologies (Downes, 2010; Siemens, 2005). These interactions are further enhanced by the individual’s capacity to decide on what, how and when to learn, as well as developing ongoing connections (Siemens, 2005; Bell, 2010).

Siemens's (2005) principles of connectivism integrate the theories of chaos, network and self-organisation complexity to produce a theoretical framework that addresses learning through knowledge transference and the individual’s abilities to acquire new knowledge. Kuna and Parrish (2014) indicate there is only partial agreement among scholars on the validity of connectivism principles in research design, and there may be more suitable ways to analyse the learning needs of contemporary students (Anderson & Dron, 2011; Kop, 2011). Bell (2011) also has concerns that connectivism theory has not been adequately researched and detailed analytics have not been conducted for long enough to make the data valid and reliable. Other scholars such as Anderson and Dron (2011) and Downes (2012) believe connectivism can only be considered as pedagogy and not a contemporary theory. However, specialists such as Downes (2012) and Siemens (2005) claim connectivism is based on practical application and theories that support the complexities of digital learning. They also consider the notable limitations of alternative theories such as behaviourism, interpretivism and constructivism and their inadequacies to effectively analyse learning networks which, according to Siemens (2005), is the place where true learning happens.

A connectivist approach uses learning networks to encourage learner discussion and is a key attribute of a cMOOC design (section 2.9.2). The format of learning networks has the potential to promote and elevate learner discussions (Kuna & Parrish, 2014) or negate the student from participating in any more meaningful and stimulating conversation (Siemens, 2005). There are generally four accepted design principles when implementing connectivism in practice (Bates, 2014; Downes, 2010, 2012; Fournier et al., 2014; Siemens, 2005), these are:

- Autonomy of the learner: Learners choose the content or skills they wish to learn, and this makes the learning more personalised.
- Diversity: Learners require a variety of learning tools to accommodate knowledge and skill differences.
- Interactivity: Learners collaborate, co-operate and communicate, resulting in emergent knowledge.
- Openness: Learners have free access to materials, activities, and assessments based on a formal curriculum and completed over a designated timeframe.

Given these four design principles and that the MOOC identified for this investigation was based on cMOOC topology, connectivism was isolated as the best theoretical model to inform the qualitative aspects of the study. The emphasis that connectivism has on student–student interactions by building learner networks and providing enhanced opportunities for learners to study (Sokolovskaya, 2015) was central in gaining a unique perspective and in-depth understanding of VET students and their perceptions of online study. To ensure this study has a balanced and well-defined mixed methodology, the relationships between the research questions, the epistemological assumptions, the theoretical framework and the specific data analysis methods used in the study are outlined in Table 4.

Table 4. *Alignment of research questions in this study to the theoretical framework layers*

Research Questions	Epistemology/ Paradigm	Approach	Theory	Strategies	Method	Specific methods
1. What are Vocational Education and Training (VET) students' perceptions of MOOC learning?	Post-positivism/ Pragmatism	Deductive	Connectivism	Case study multiple iterations scientific method	Mono	2: Baseline analytics 4: Retrospective causal-comparative design 6: Comparative analysis 7: Qualitative techniques
2. What are the factors identified in student engagement and retention for VET MOOCs?	Post-positivism/ Pragmatism	Deductive	Connectivism	Case study multiple iterations scientific method	Mono	2: Baseline analytics 3: PCA, CFA & SEM analysis 4: Retrospective causal-comparative design 5: Direct logic regression modelling 6: Comparative analysis 7: Qualitative techniques
3. What are the relationships between student retention in VET MOOCs, SPOCs, and online environments?	Post-positivism/ Pragmatism	Deductive	Connectivism	Case study scientific method	Mono	2: Baseline analytics 4: Retrospective causal-comparative design 6: Comparative analysis 7: Qualitative techniques
4. What are the relationships between student engagement in VET MOOCs, SPOCs, and online environments?	Post-positivism/ Pragmatism	Inductive & Deductive	Connectivism	Case study scientific method	Mono	2: Baseline analytics 4: Retrospective causal-comparative design 6: Comparative analysis 7: Qualitative techniques
5. How effective is the evolutionary development of a best practice MOOC design in maximising student engagement and retention?	Post-positivism/ Pragmatism	Inductive	Connectivism	Action research	Mixed	1: Phase analysis 2: Baseline analytics 6: Comparative analysis

3.3 Research approach

The approach followed for this study adopts aspects of action research (Hine, 2013) and connectivism theory (section 3.2.3) informed by a post-positivist stance (section 3.2.1) and reinforced by pragmatic foundations (section 3.2.2). Action research is a significant educational problem-solving tool for participatory, reflective and case-specific (Cohen et al., 2007) inquiries. It takes a systematic and relationship approach to theory and practice by exploring the ways knowledge informs the learning process. The aim of action research is to examine the effects of change on the learning environment and to prompt improved teaching practices. However, as it is not considered a genuine scientific methodology (Kemmis, McTaggart, & Nixon, 2013), this study used post-positivist evidence in parallel with cyclical action research data to maintain a balanced approach to the inquiry. This research employed an inductive and deductive examinations of learner engagement and retention attributes in a cross-sectional study spanning three years. Through reflective practices (Kemmis et al., 2013) learners across 15 MOOCs, 6 SPOCs (section 3.3.3) and 6 online delivered courses (section 3.3.4) were reviewed and both qualitative and quantitative data enrich the study. The action research process for the study is modelled in Figure 1.

As action research is “cyclical, dynamic and collaborative in nature” (Hine, 2013, p. 151) and multiple repetitions of planning, observing and reflecting can provide social improvement strategies, the research was performed in three phases:

Phase 1: Testing - Descriptive comparisons and non-parametric independent samples testing of learner completion data for three different initial course delivery formats to determine any significant changes against the research predictors.

Phase 2: Comparison - Implementation of Phase 1 outcomes into two later course deliveries. Descriptive comparisons and non-parametric independent samples testing of learner completion data to determine any significant patterns in engagement and retention.

Phase 3: Evaluation - Descriptive comparisons, non-parametric independent samples testing, structured equation modelling techniques and qualitative analysis of learner data in all course deliveries to determine a VET learner profile and the factors that promote learner engagement and retention.

Phase 1: Testing reviewed learner completion data which were measured against the empirically supported research predictors: assessment structure, sense of community, course content flow and instructor accessibility (section 3.3.2) and illustrated by the SLR engagement and retention tree (Figure 3). These predictors provided a systematic tool to determine the most suitable factors to implement in Phase 2: Comparison of the research. The design of the MOOC/SPOC enabled systematic changes to be conducted to each subsequent course which allowed the researcher to assess how each predictor affected learner completions. However, the online course structure and the platform constraints did not permit this flexibility and minimalistic data was obtained against the predictors for online courses. Although the data from the online courses were minimal, they did provide additional justifications and contributed to the triangulation of the data to give the research findings more depth and influence (Greene et al., 1989). Phase 2: Comparison implemented the outcomes from Phase 1: Testing into MOOC 11 and SPOC 6 where a further quantitative analysis of learner completion data against the four research predictors was conducted. The findings from each phase were brought together in the third phase for the final analysis of all MOOCs, SPOCs, and online learner data as illustrated in Figure 5.

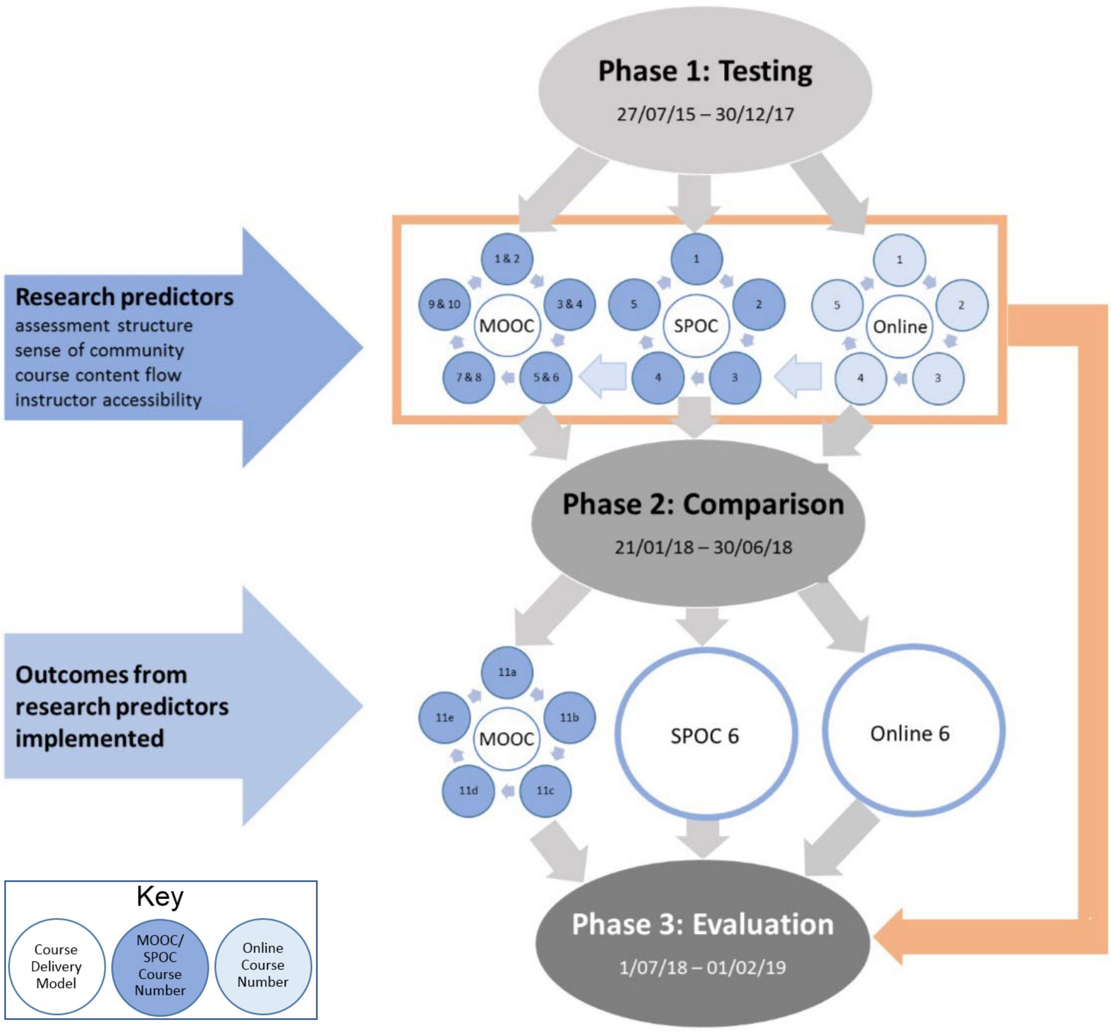


Figure 5. Phases of the action research process.

The final phase used both inductive and deductive approaches (Cohen et al., 2007) to analyse the data obtained from each data source. There were five data sources employed for the MOOCs/SPOCs and five different sources for online delivered courses. The data for the MOOCs/SPOCs were gathered through the Welcome to Canvas Survey; the User Experience Survey; Canvas course progress analytics; Canvas course completion analytics; and Canvas discussion board posts. Online course data were obtained through the eLearn course progress analytics; eLearn course completion analytics; eLearn discussion board posts; CIT learner enrolment forms; and CIT Subject Evaluations. Over-evaluation of students and survey fatigue was an important aspect to consider in this research and Porter, Whitcomb, and Weitzer (2004) advise that administering multiple surveys over one year can significantly reduce the response rates of later surveys. Therefore, no additional surveys were developed specifically for this research and the two pre-designed survey instruments from Canvas and the final course evaluation from CIT was used instead. The data sources for the research detailed against the research questions, themes, categories and functional approaches for this study are presented in Table 5 for MOOC/SPOC and Table 6 for online delivery.

Table 5. *Research questions, themes, functional approaches & component categories for MOOC/SPOC data sources, applied methods, and study variables*

Research questions	**Themes aligned to functional approaches**	**Component categories**	**Welcome to Canvas Survey**	**User Experience Survey**	**Canvas Course Progression Analytics**	**Canvas Course Analytics**	**Canvas/ Facebook Discussion Board Analytics**
1. What are Vocational Education and Training (VET) students' perceptions of MOOC learning?	Student perceptions of MOOCs by providing opportunities for learners to collaboration, gain certification for course achievement & pathways to further study	Learner's sense of community (section 5.2.1)	$M^{2,6,7}$ Comments	$M^{2,6,7}$ Comments		$M^{4,6}$ B6	$M^{2,4,6}$ A28,C1-C9,Facebook
		Certification & pathways (section 5.2.2)	$M^{2,4,6,7}$ A2,Comments	$M^{6,7}$ A15,A16, Comments		$M^{4,6}$ A29,B6	
		Enjoyment of course & free vs fees (section 5.2.3)	$M^{2,6,7}$ Comments	$M^{2,6,7}$ Comments		$M^{4,6}$ A29,B6	$M^{4,6}$ A28
2. What are the factors identified in student engagement and retention for VET MOOCs?	Engagement and retention factors by evaluating an instructor's commitment to timely contextualised communication	Instructor commitment & time zone variances (section 5.3.1)	$M^{6,7}$ Comments	$M^{2,6,7}$ A17, Comments			M^{4} C6-C9
		Patterns of participation & learner's willingness to engage (section 5.3.2)	$M^{2,3,4}$ A1-A11		M^{5} D1-D56	$M^{4,6}$ B6	
		Content release preferences (section 5.3.3)	M^{4} A3	M^{4} A14, A18		M^{6} A29,B6	M^{6} A28
3. What are the relationships between student retention in VET MOOCs, SPOCs, and online environments?	Aspects promoting student retention through good quality instructional course design	Instructional course design & MOOC topology (section 5.4.1)	M^{7} Comments	$M^{2,4,6,7}$ A12,A13,A16, Comments			
4. What are the relationships between student engagement in VET MOOCs, SPOCs and, online environments?	Student engagement relationships by incorporating well-developed assessment tasks aligned with course objectives	Assessment construction and tasks (section 5.5.1)	M^{7} Comments	M^{7} Comments		$M^{4,6}$ B1-B6	
		Prerequisites and demographic factors (section 5.5.2)	$M^{2,3,4}$ A1-A11,Comments	$M^{2,3,4,6}$ A12-A23,Comments			
5. How effective is the evolutionary development of a best practice MOOC design in maximising student engagement and retention? (section 5.6)			$M^{1,2,6}$ A1-A11	$M^{1,2,6}$ A12-A23	M^{1} D1-D56	$M^{1,2,6}$ A29,B1-B6	$M^{1,2,6}$ A28,C1-C9

M^n Specific methods: 1: Phase analysis, 2: Baseline analytics, 3: PCA, CFA & SEM analysis, 4: Retrospective causal-comparative design, 5: Direct logic regression modelling, 6: Comparative analysis, 7: Qualitative techniques.

A full description of the corresponding course variables is available from Appendix H.

Table 6. *Research questions, themes, functional approaches & component categories for online data sources, applied methods, and study variables.*

Research questions	**Themes aligned to functional approaches**	**Component categories**	**CIT Learner Enrolment Form**	**CIT Subject Evaluation**	**eLearn Course Progression Analytics**	**eLearn Course Analytics**	**eLearn Discussion Board Analytics**
1. What are Vocational Education and Training (VET) students' perceptions of MOOC learning?	Student perceptions of MOOCs by providing opportunities for learners to collaboration, gain certification for course achievement & pathways to further study	Learner's sense of community (section 5.2.1)	$M^{2,6,7}$ A1-A11	$M^{2,6,7}$ Comments		$M^{4,6}$ B6	$M^{2,4,6}$ A28,C1-C9
		Certification & pathways (section 5.2.2)	$M^{2,6,7}$ A1-A11	$M^{6,7}$ A16Comments		$M^{4,6}$ A29,B6	
		Enjoyment of course & free vs fees (section 5.2.3)		$M^{2,6,7}$ Comments		$M^{4,6}$ A29,B6	$M^{4,6}$ A28
2. What are the factors identified in student engagement and retention for VET MOOCs?	Engagement and retention factors by evaluating an instructor's commitment to timely contextualised communication	Instructor commitment & time zone variances (section 5.3.1)		$M^{2,6,7}$ A17,Comments			M^{4} C6-C9
		Patterns of participation & learner's willingness to engage (section 5.3.2)	M^{3} A1-A11		M^{5} D1-D56	$M^{4,6}$ B6	
		Content release preferences (section 5.3.3)	M^{4} A3			M^{6} A29,B6	M^{6} A28
3. What are the relationships between student retention in VET MOOCs, SPOCs, and online environments?	Aspects promoting student retention through good quality instructional course design	Instructional course design & MOOC topology (section 5.4.1)		$M^{2,4,6,7}$ A12,A13,E1,E5,E6, Comments			
4. What are the relationships between student engagement in VET MOOCs, SPOCs and, online environments?	Student engagement relationships by incorporating well-developed assessment tasks aligned with course objectives	Assessment construction and tasks (section 5.5.1)	M^{7}	M^{7} Comments		$M^{4,6}$ B1-B6	
		Prerequisites and demographic factors (section 5.5.2)	$M^{2,4}$ A1-A11				
5. How effective is the evolutionary development of a best practice MOOC design in maximising student engagement and retention? (section 5.6)							

M^{n} Specific methods: 1: Phase analysis, 2: Baseline analytics, 3: PCA, CFA & SEM analysis, 4: Retrospective causal-comparative design, 5: Direct logic regression modeling, 6: Comparative analysis, 7: Qualitative techniques.

A full description of the corresponding course variables is available from Appendix H.

3.3.1 The sampling technique

The learners who enrolled in the MOOCs, SPOCs, and online courses between 27 July 2015 and 30 June 2018 were the population for the research. The learners who gave consent were the sample population for the detailed individual analysis. Purposive sampling (Cohen et al., 2007) was used to collect data and not all survey questions or data variables were used. Only the questions and variables that addressed the issues raised by the research questions were selected. This sampling technique gives the research a higher probability that a wider population sample will be selected and, in the process, gathering as much information as possible about the engagement and retention attributes of VET learners.

3.3.2 Research predictors

The literature evaluation (see for example Admiraal et al., 2015, Bruff et al., 2013; Hew, 2014; Kellogg et al., 2014) identified four research predictors: assessment structure, sense of community, course content flow and instructor accessibility as factors that fostered greater levels of learner engagement and promoted student retention. Each predictor was analysed and the course modified after each iteration of the 10 MOOCs and 5 SPOCs in Phase 1: Testing, as depicted in Figure 6.

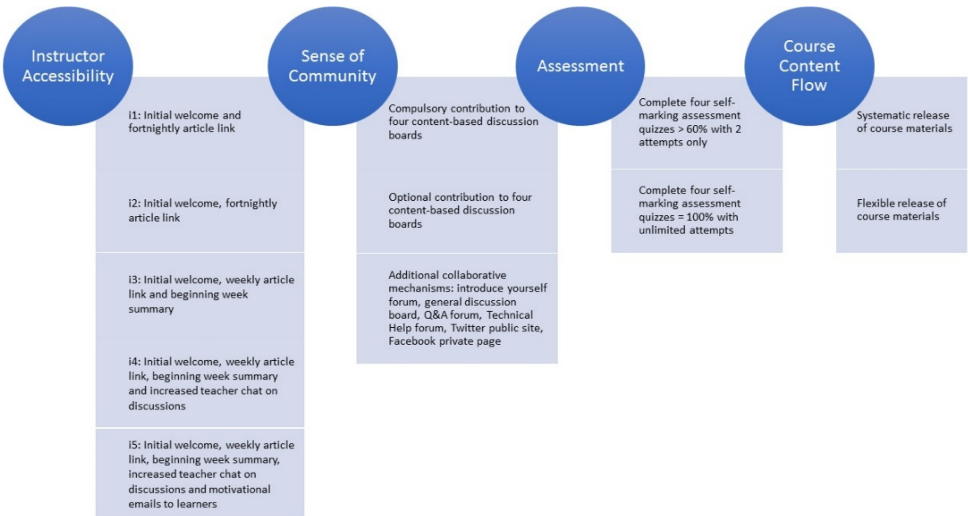


Figure 6. Continuous improvement mechanisms for research predictors.

The data output from each iteration provided a continuous improvement mechanism to further enrich the MOOCs' and SPOCs' design, learning resources and assessment instruments for the next time they were run. An individual and combined descriptive and inferential statistical testing of all MOOCs and SPOCs provided the final structure for the eleventh MOOC and sixth SPOC iteration in Phase 2: Comparison. The MOOCs and SPOCs were delivered over four weeks and the distinct design factors of each course with the possible consequences and drop-out risks are shown in Appendix B. However, it should be noted that the eleventh MOOC iteration did not have a designated timeframe for completion and was available for study at any time. For the data analysis, MOOC 11 was divided into four-weekly blocks and evaluated as five individual groups as MOOC 11a–e. MOOC 11 was also examined as one complete learner group which provided an additional understanding of how completion timeframes affect learner retention.

3.3.3 MOOC and SPOC overview

The CIT VET MOOC, Biometric Technologies: Identification for the Future was initially developed in response to an industry skill shortage of qualified biometric professionals. The course was developed using cMOOC andragogy (section 2.9.2) and offered on Canvas.net, which is a globally recognised MOOC platform. The Canvas Network supports cMOOC structures as their learning platform promotes learner autonomy through numerous open and free course offerings. The UoC (Unit of Competency) CPPSEC2019A Monitor Biometric Equipment and Systems (available from training.gov.au) from the Certificate IV in Biometric Technologies qualification was identified as the most suitable unit to develop into the MOOC. This unit encompassed the basic skills required to understand biometric technologies, the underlying concepts of biometrics for identification and had a futuristic topic to entice learners. The CIT course was developed as a MOOC by using the underpinning requirements of the UoC and included diverse interactive learning tools that were strategically integrated throughout the content to cater for learners at different academic levels (Bates, 2014; Downes, 2010; Fournier et al., 2014; Siemens, 2005).

The learning materials developed for the CIT MOOC were also adopted as the content for the SPOC. This allowed for better data comparability across both learning environments. However, the difference between MOOC and SPOC learners was that MOOC students enrolled, incurred no fees and on successful completion gained a certificate of participation, whereas SPOC students completed a formal CIT enrolment process and paid the unit fee before completing the MOOC. On MOOC success, SPOC students gained the MOOC certificate of participation and also had the additional requirement of completing the summative assessment before being deemed competent and gaining a CIT statement of results for the Monitor Biometric Equipment and Systems unit. As SPOC learners were enrolled in a CIT program of study, they also had access to the CIT eLearn platform which provided them with additional online tools and resources such as the library and student services. These facilities were not available to MOOC students.

3.3.3.1 Course design and educational pathways

The Biometric Technologies: Identification for the Future MOOC was completed over four weeks as shown in Figure 7 and each weekly module was subdivided into 10 discrete units of learning as displayed in Figure 8.

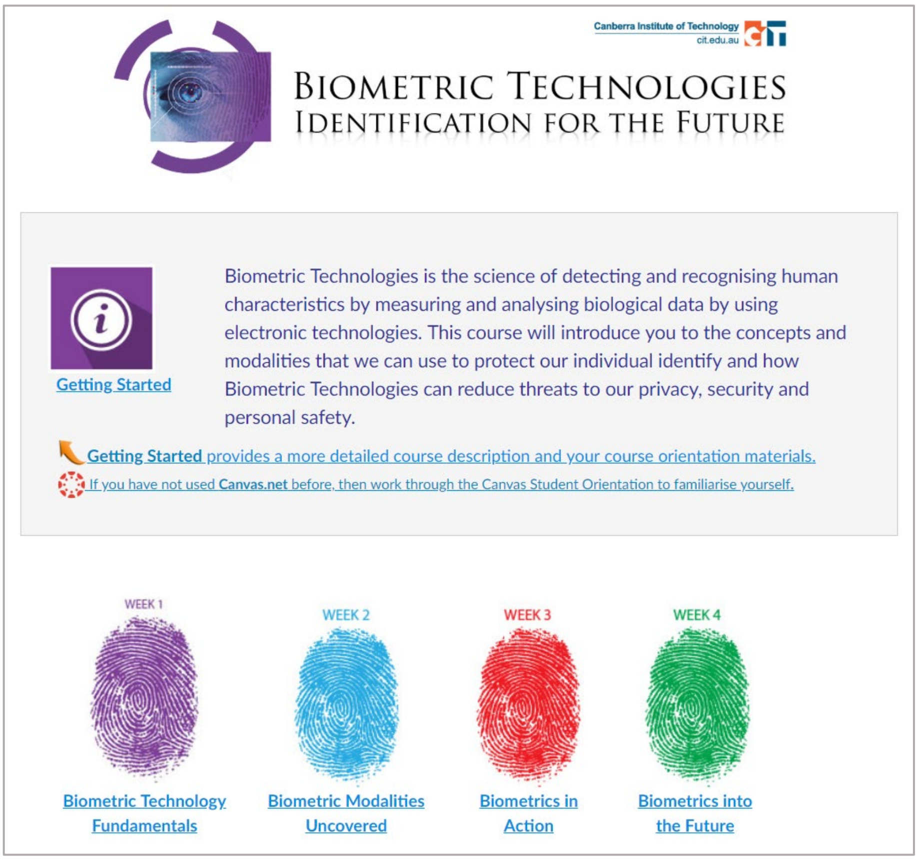


Figure 7. Biometric Technologies: Identification for the Future MOOC Home Page.

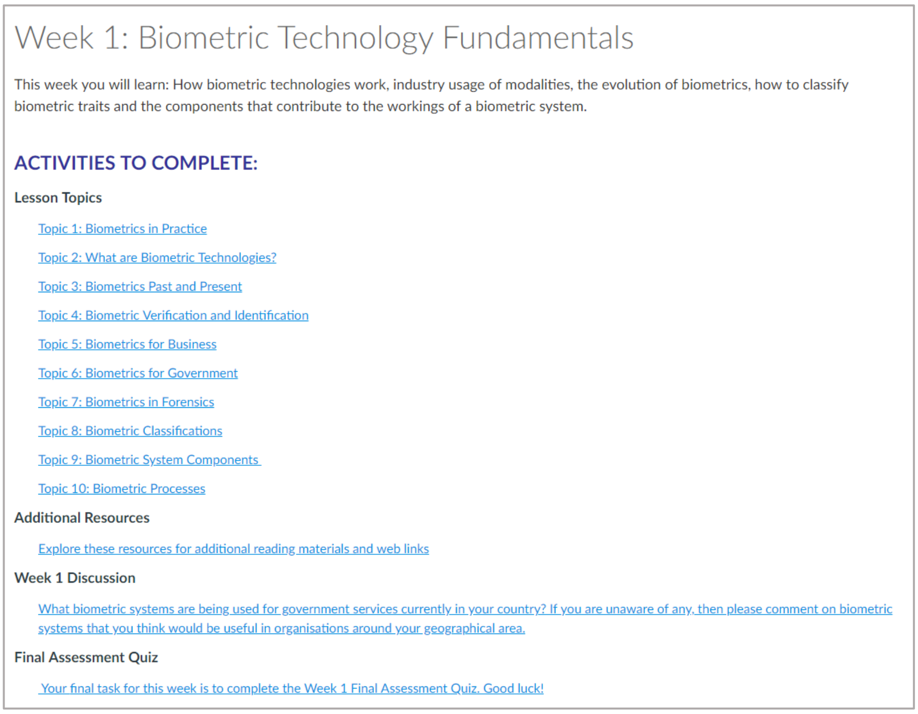


Figure 8. MOOC layout structure for Week 1.

Each module was delivered through videos that pause at pertinent moments to enable the learner to develop the practical skills through gamified application (Rai & Chunrao, 2016). The gamification strategies were initially run through an online interface called Zaption. However, as they discontinued their services in 2016, all videos were converted into Playposit (available from playposit.com). Playposit video interactivity was delivered in the form of questions, practical activities, and chat. Each unit also included interactive PDFs for students who prefer reading to watching. The PDFs could be used as an additional resource to reinforce learning. Using a variety of delivery tools improves learner proficiency and better supports an individual's learning style through autonomous self-reflective activities (Gamage et al., 2014). Each week the student contributed to a discussion board question and further communication was achieved through weekly teacher emails, postings on a biometric technologies Twitter site and conversations through a private Facebook group (Veletsianos et al., 2015). After each module, 10 multiple-choice auto-graded questions were used to formatively assess the learners' knowledge and practical application of skills. Once the student successfully completed the four final weekly assessments, they received a certificate of completion. MOOC students were offered an additional pathway through the skills recognition process to achieve the UoC (Rosewell & Jansen, 2014) and on credit of this, the student was able to enrol in the Certificate IV in Biometric Technologies qualification (Green et al., 2015; Hone & El Said, 2016). SPOC students, on the other hand, completed the final summative assessment, if deemed competent they were awarded the UoC and then had the opportunity to continue with the next unit in the Certificate IV. A flowchart of the educational pathway from MOOC to recognised CIT qualifications is presented in Figure 9.

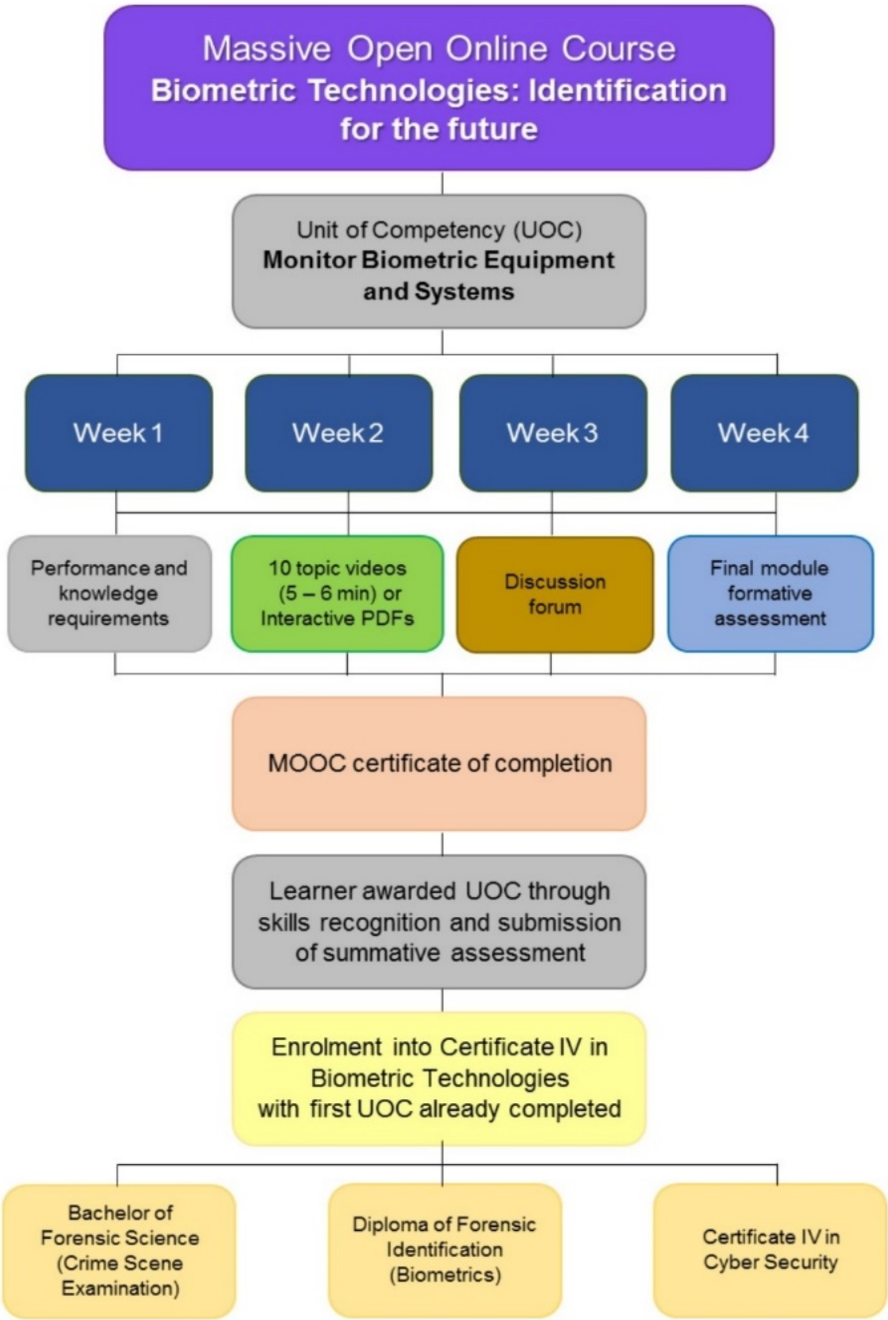


Figure 9. The educational pathway from MOOC to formal qualifications flowchart.

3.3.3.2 MOOC and SPOC participants

All learners enrolled in the MOOC and SPOC were invited on course commencement to participate in this research study and provided with the study information as shown in Appendix C. Informed consent was optional and obtained once the student provided their agreement in question 1 of the

Welcome to Canvas Survey. Only consenting participants and learners over 18 years of age were included in the final data sample. Some consenting students had selected the age option 13–18 years old. As it was impossible to determine from the available information if the learner was indeed over 18, these learner records were removed from the study. After the MOOC and SPOC iterations' consenting participants were compared to the total number of learners that initially enrolled. The results from this analysis are presented in Table 7.

Table 7. *MOOC and SPOC participants*

Course	**Delivery Timeframe**	**Total Enrolled**	**Consenting Participants**	**% Consented against Enrolled**
MOOC 1	Sept 15–Oct 15	734	121	22.3%
MOOC 2	Nov 15–Dec 15	474	82	15.1%
MOOC 3	Mar 16–Apr 16	347	48	8.8%
MOOC 4	May 16–Jun 16	194	42	7.7%
MOOC 5	Aug 16–Sep 16	146	40	7.4%
MOOC 6	Oct 16–Nov 16	218	25	4.6%
MOOC 7	Feb 17–Mar 17	100	26	4.8%
MOOC 8	May 17–Jun 17	84	35	6.4%
MOOC 9	Aug 17–Sep 17	104	18	3.3%
MOOC 10	Oct 17–Nov 17	165	39	7.2%
MOOC 11 (totals)	Jan 18–Jun 18	397	67	12.3%
MOOC 11a	Jan 18–Feb 18	194	30	5.5%
MOOC 11b	Feb 18–Mar 18	63	6	1.1%
MOOC 11c	Mar 18–Apr 18	67	16	2.9%
MOOC 11d	Apr 18–May 18	34	6	1.1%
MOOC 11e	May 18–Jun 18	39	9	1.7%
Total MOOC (n)		2963	543	
SPOC 1	Jul 15–Aug 15	16	6	12.8%
SPOC 2	Feb 16–Mar 16	10	2	4.3%
SPOC 3	Jul 16–Aug 16	8	4	8.5%
SPOC 4	Feb 17–Mar 17	13	8	17.0%
SPOC 5	Jul 17–Aug 17	19	10	21.3%
SPOC 6	Feb 18–Mar 18	32	17	36.2%
Total SPOC (n)		98	47	45.5%
Total MOOC/SPOC (N)		3061	590	

It should be noted that as of 2018 the Biometric Technologies: Identification for the Future MOOC became available for enrolment at any time. MOOC 11 opened on 23 January 2018 and was not due to close until 21 January 2019, as SPOC students could no longer enrol in their own dedicated course they were subsumed in MOOC 11. For data uniformity in this study, the SPOC students were removed from the MOOC 11 dataset and data recorded against SPOC 6.

3.3.3.3 MOOC and SPOC data collection

The data collection gathered information from 15 MOOC and 6 SPOC iterations over three years. The variables identified for MOOC and SPOC course analytics for this study were substantiated by the research conducted by Paton, Scanlan, et al. (2018). Their research evaluated 10 variables that are predictive of learner performance, namely: number of enrolled students, number of students who started, number of students who successfully completed, proportion of students who finished, number of student discussion contributions, number of video lectures viewed by students and the grades for assessments 1, 2, 3 and 4. Therefore, the initial data analysed from 3061 enrolled learners (MOOC: 2963; SPOC: 98) included the following variables:

- Enrolled: Number of students who completed the enrolment process.
- Started: Number of students who completed the first learning activity or viewed the initial topic video.
- Completed: Number of students who successfully completed the entire MOOC.
- Completed/Started: Proportion of MOOC students who started and completed the course.

The course analytics were extracted for 476 MOOC and 30 SPOC consenting learners from Phase 1: Testing and 67 MOOC and 17 SPOC consenting learners from Phase 2: Comparison.

The individual variable data for each student enrolled in the MOOC or SPOC was recorded as:

- Posts: Number of times the student contributed to discussion boards.
- Videos: Number of video lectures viewed by the student.
- Assessment one: Learner grade for assessment 1.
- Assessment two: Learner grade for assessment 2.
- Assessment three: Learner grade for assessment 3.
- Assessment four: Learner grade for assessment 4.

Additional data variables for the quantitative analysis involved charting each learner as they travelled through the course to give insight into the topics that were most and least frequented by the student. Each topic was documented as either completed or not completed for each of the 56 course pages which included topics 1–10, additional resources, discussion forums and final assessment quiz pages for each of the four weeks. These data delivered a broader understanding of learner engagement and the course attributes that enhanced or negated retention.

During the course, learners also completed two electronic surveys which provided quantitative and qualitative data for the study. These were:

1. Welcome to Canvas Network Survey: On commencement of the MOOC or SPOC, the pre-course survey shown in Appendix D was used to ascertain the learner's consent in question 1, the reasons for taking the subject, highest level of education, demographics, gender, and level of education, etc. The survey was taken before the student commenced week 1 and included a mixture of Likert multiple choice questions and informative multiple-choice questions for quantitative analysis and two open questions for qualitative interpretation.

2. User Experience Survey: The survey presented in Appendix E was completed after the student finished week 3. The post-course survey determined how well the student enjoyed the course and suggested

comments for change etc. This survey also included a mixture of Likert multiple choice questions and informative multiple choice questions for quantitative analysis and two open questions provided additional qualitative data to better evaluate the learner's course experience.

The generic Canvas-designed pre-course, Welcome to Canvas Network Survey and post-course, the User Experience Survey, were both evaluated and the important themes for the research extracted. The evaluation identified:

- The number of students who replied to the pre-course survey was considerably higher (99%) than those who responded to the post-course survey (51%).
- The responses to both surveys were not consistent and there was a variation in response rate for each question.
- Not all survey questions were used and only the questions that addressed the themes, categories, and functional approaches of the research were selected.
- To acknowledge the variation in survey questions and to record reliable responses, an additional value was included in the dataset for each question to indicate "No response" to any question that did not get a reply.

The pre- and post-course survey questions identified some of the attributes of learner engagement and retention across three of the four research themes, student perceptions of MOOCs, engagement and retention factors and aspects promoting student retention (Figure 3). However, the fourth theme, student engagement relationships, was mainly evaluated using quantitative analysis of learner completion data. The alignment of pre- and post-survey questions to each theme and component category is shown in Table 8.

Table 8. *MOOC/SPOC pre- and post-survey questions for study themes and component categories*

Theme	Component categories	Welcome to Canvas Survey (Pre-survey)	User Experience Survey (Post-survey)
Student perceptions of MOOCs	Learner's sense of community (5.2.1)	Q5 & Q13 (Comments)	Q4 & Q16 (Comments)
	Certification & pathways (5.2.2)	Q3 (A2) Q5 & Q13 (Comments)	Q5-–Q6 (A15–A16) Q4 & Q16 (Comments)
	Enjoyment of course & free vs fees (5.2.3)	Q5 & Q13 (Comments)	Q4 & Q16 (Comments)
Engagement and retention factors	Instructor commitment & time zone variances (5.3.1)	Q5 & Q13 (Comments)	Q7 (A17) Q4 & Q16 (Comments)
	Patterns of participation & learner's willingness to engage (5.3.2)	Q3 (A2)	
	Content release preferences (5.3.3)	Q4 (A3)	Q5 (A14), Q8 (A18)
Aspects promoting student retention	Instructional course design & MOOC topology (5.4.1)	Q5 & Q13 (Comments)	Q1–Q2 (A12–A13), Q6 (A16) Q4 & Q16 (Comments)
Student engagement relationships	Assessment construction and tasks (5.5.1)	Q5 & Q13 (Comments)	Q4 & Q16 (Comments)
	Prerequisites and demographic factors (5.5.2)	Q1–Q12 (A1–A11) Q5 & Q13 (Comments)	Q1–Q16 (A12–A23) Q5 & Q13 (Comments)

The course analytics, course progression statistics, discussion board posts, and both survey responses were combined for each learner. The data were then de-identified and imported into SPSS V25 software for further analysis. Means and standard deviations were calculated for each MOOC and SPOC iteration and independent samples testing was conducted to determine any significant changes between Phase 1: Testing and Phase 2: Comparison courses.

3.3.4 Online delivery overview

To provide triangulation of MOOC and SPOC data (section 3.3.3), two fully online units from stage 1 of the CIT's Certificate IV in Biometric Technologies qualification were selected. The units, FSCBMT401 Principles of Biometric Technologies and FSCBMT403 Apply Forensic Digital Imaging Techniques (available from training.gov.au), were isolated for this research as they were units the learner studied early-on in their Certificate IV studies and discipline-specific to make the research more comparable. Both units were delivered over 16 weeks with the content and teacher interactions managed through eLearn. eLearn is CIT's online delivery platform and it gives the student a usable electronic learning management system that is relatively easy to use and it has well-developed support structures should technology issues arise. Both online units had a longer duration than the MOOC/SPOC (4 weeks) and included two additional assessment tasks. Therefore, the assessments and online learner progression classifications were converted into a consistent format. The six assessments were reduced to four measurable tasks with assessment 1, 3, 5 and 6 recorded. The weekly progression was also modified from 16 weeks to four weeks and only weeks 1, 5, 10 and 15 were logged for the online group.

The CIT online courses use e-Learning andragogy (Gamage et al., 2014) and competency-based training approaches. The two online units evaluated in this study use a wide range of information sources such as websites, toolbox applications, written information, electronic classrooms, and quizzes, to deliver learning concepts. Assessments are both formative and summative and are a critical element of validating a learner's competence. Online assessments include self-marking quizzes, discussion forums, written assessments, portfolios, and timed projects which are teacher assessed.

3.3.4.1 Online course participants

Each CIT student self-selected their studies by enrolling in a unit through the student online management system. On commencement of either the Principles of Biometric Technologies or Apply Forensic Digital Imaging Techniques units, the learner was provided with the study information as shown in Appendix C. Learner consent was then confirmed once the student provided agreement to the eLearn research consent quiz which is provided in Appendix F. Only students who gave consent and were over 18 years of age were included in the final online sample. The combined consenting participants for each online course and the total number of learners enrolled are listed in Table 9.

Table 9. *Online courses participants*

Course	**Total Enrolled**	**Consenting Participants**	**% Consented against Enrolled**
Online 1	18	14	78%
Online 2	26	8	31%
Online 3	12	10	83%
Online 4	28	15	54%
Online 5	28	26	93%
Online 6	65	20	31%
Total Online (n)	177	93	53%

3.3.4.2 Online course data collection

The data collection gathered information from 12 sources this encompassed two online CIT units, Principles of Biometric Technologies and Apply Forensic Digital Imaging Techniques evaluated over six course iterations. The variables for the online data were constructed on the MOOC and SPOC data variables and the research conducted by Paton, Scanlan, et al. (2018). For those reasons, the course analytics for all online students (n=177) were extracted in the same way as MOOC/SPOC and were comprised of enrolled, started, completed and completed/started.

The individual data for the 93 consenting students enrolled in the CIT online courses were collected and recorded against the following variables:

- Posts: Number of times the student contributed to the discussion board for the unit: Apply the Principles of Biometric Technologies.
- Summative Assessment one: Mean learner grade for assessment 1.
- Summative Assessment two: Mean learner grade for assessment 2.
- Formative Assessment three: Mean learner grade for assessment 3.
- Formative Assessment four: Mean learner grade for assessment 4.

Additional demographic data for each learner were obtained from the student's enrolment form including place residing, primary language, gender, highest education level, age and reason for studies. Previous online experience was assumed as all learners had completed a previous online unit in the Certificate IV qualification and/or the MOOC. Learners' course progress was charted but as the course was 16 weeks in duration, only weeks 1, 5, 10 and 15 were used for analysis and coded with completed or not completed, the same variables as the MOOC/SPOC data. The learners progressing through each topic activity was recorded twice for each of the 4 weeks with a total of 8 progressions recorded for each learner. It should be noted that there was no designated discussion activity for learners studying Apply Forensic Digital Imaging Techniques; therefore, no data were obtained for this group against that variable.

Learners in the online group also had the opportunity to complete an anonymous end-of-subject evaluation. The survey included a mixture of Likert multiple choice questions (strongly agree, agree, neutral, disagree, strongly disagree) and two open questions. The Subject Evaluation is shown in Appendix G. Although this post-course survey is standard for all CIT courses, not all survey questions were used in the research and only the themes, categories and functional approaches that enriched the MOOC/SPOC post-course questions were extracted for the research. Each question and its corresponding response was meticulously analysed to gain an understanding of the underlying meaning and was designated one of the values provided by the User Experience Survey (Appendix E) instrument. The alignment of post-survey questions from the MOOC/SPOC in comparison to the CIT Subject Evaluation questions is outlined in Table 10.

Table 10. *Comparable post-course MOOC/SPOC survey and CIT Subject Evaluation questions*

Question in CIT Subject Evaluation		**Canvas User Experience Survey**	
E1	What overall rating would you give the subject?	A16	Please give this course an overall rating?
	1 Poor to 5 Excellent		1 Lowest to 5 Highest
E5	The resources for this subject were sufficient?	A12	The course materials (lectures, videos, documents) have a positive impact on my learning experience?
	1 Strongly Disagree		1 Strongly Disagree
	2 Disagree		2 Disagree
	3 Neutral		3 Neither Agree nor Disagree
	4 Agree		4 Agree
	5 Strongly Agree		5 Strongly Agree
E6	The resources were easy to understand?	A13	The course activities (discussions, assignment, project, quizzes) have a positive impact on my learning experience?
	1 Strongly Disagree		1 Strongly Disagree
	2 Disagree		2 Disagree
	3 Neutral		3 Neither Agree nor Disagree
	4 Agree		4 Agree
	5 Strongly Agree		5 Strongly Agree

The similarities between the survey selections allow these three questions to be directly compared for this study. However, the variation of students who responded to the survey was quite low and only 26% of consenting participants (n=24) submitted a response. Because of the inconsistency in response rate, this survey was only used to generate an understanding and comparison of this group, not to prove or disprove a concept or theory. All data instruments including the course progression analytics, course completion analytics, and discussion board posts were combined for each online learner, de-identified and imported into SPSS V25 software. For each online iteration, the means and standard deviations were calculated, and independent samples testing conducted to determine any significant changes between iterations and to inform Phase 1: Testing and Phase 3: Evaluation. However, as the CIT Subject Evaluation (Appendix G) was anonymous, this was not identified against an individual and was analysed separately to the individual online learner data.

3.3.5 Data analysis

The final phase of the research concentrated on the analysis of 67 MOOC, 17 SPOC, and 20 online learners. The mix of quantitative and qualitative data from MOOCs and SPOCs compared with online learners allowed for triangulation of information between and across learners and learning environments. The data collection spanned 48 variables about the learner and their studies, and 66 variables recorded the pages visited by each learner. For online courses, the analysis explored 20 comparable variables and 16 variables for the learner's page progression statistics. The research variables detailed for the study including a description, values gathered and the equivalent data sources that informed the research is detailed in Appendix H and the variables of learner completions against page progression are listed in Appendix I.

The examination of different but complementary data sources builds a stronger understanding of the research inquiry (Creswell, 2014). The dominant method employed by this research "relies on a quantitative, post-positivist view of the research process, while concurrently recognising that the addition of qualitative data and approaches are likely to benefit most research projects" (Johnson, Onwegbuzie, & Turner, 2007, p. 124). This is confirmed by Sieber (1973), where qualitative data can assist the quantitative components of the study and both aid with data conceptualisation. The mixed method convergent embedded design outlined by Creswell, Plano Clark, Gutmann, and Hanson (2003) was used as the framework for the data analysis as illustrated in Figure 10.

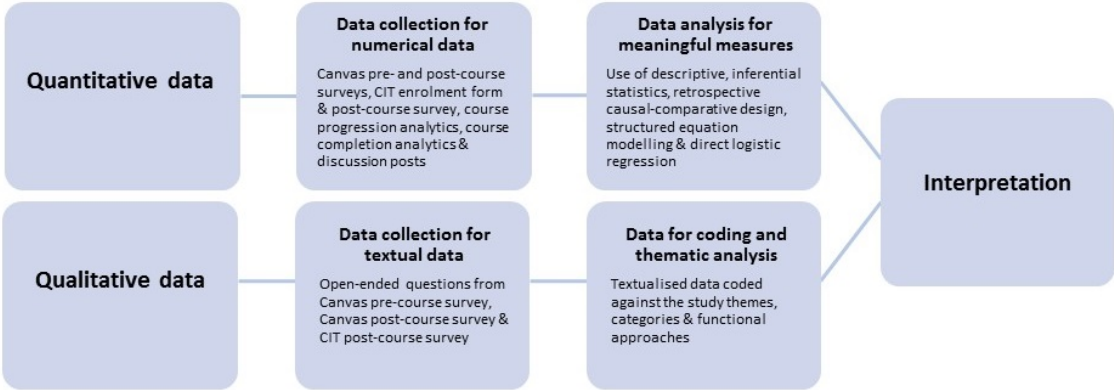


Figure 10. Creswell's mixed-method embedded design, showing the data analysis process engaged in this study.

The sample sizes converged across the MOOCs, SPOCs and online courses and the embedded nature of the data sources warranted a design that used the simultaneous collection of primary quantitative data and supportive qualitative data to address the research questions. The combination of data analysis methods used in this study included descriptive and inferential statistics and thematic analysis of open-ended questions. The implementation of these strategies is advocated by Veletsianos and Shepherdson's (2016) research on empirical MOOC papers. They presented descriptive statistics (93.4%), correlational analysis (52.5%) and basic qualitative information (38.8%) as the top three data analysis methods used in existing MOOC literature.

3.3.5.1 Quantitative techniques

The data from the Welcome to Canvas Network Survey (Appendix C), the Canvas User Experience Survey (Appendix D), CIT Subject Evaluation (Appendix G), course progression analytics, course completion analytics and discussion board posts for all learners (MOOC/SPOC/online) were coded against the study variables. Each variable was correlated to a theme, category or functional approach and these, in turn, were related back to the research inquiry questions as displayed in Table 5 and Table 6. A logical research approach was instigated as it connected the empirical data to the research questions to determine an ultimate conclusion (Yin, 2011). Future guidance on the descriptive and correlation techniques used in this research was gained from the quantitative study conducted by Paton, Scanlan, et al. (2018). Therefore, six quantitative evaluation techniques were employed, these being:

1. **Phase analysis:** Applied means, standard deviations and statistical inference of Phase 1: Testing, Phase 2: Comparison and Phase 3: Evaluation data variables to determine any significant differences between learners, course modes, course iterations and their effect on engagement and retention relationships.
2. **Baseline analytics:** Frequencies and descriptive statistics from MOOC, SPOC and online learners to obtain a baseline for further comparison and to provide additional data to support further descriptive outcomes. Baselines will be included in the Research Findings chapter (Chapter 4) for all completion variables but as advised by Paton, Scanlan, et al. (2018, p. 4) “when retention is grounded on MOOC students completing a significant piece of learning, a more tangible commencement point can be identified and in practice, completion rates are improved”. Established on this finding the Discussion chapter (Chapter 5) will apply the variable 3 Learner’s started W1T1 (Week 1 Topic 1) for the main comparisons and analysis.

3. **PCA, CFA & SEM analysis:** The factors that impacted on MOOC learner engagement and retention were initially assessed with deductive Principal Components Analysis (PCA) and inductive Confirmatory Factor Analysis (CFA). Then Structured Equation Modelling (SEM) was conducted using AMOS V25 for analysis of moment structures and the coexisting contributions of study variables. The SEM was used to test and estimate causal relations using a combination of observed and latent variables (Hoyle, 1995). The systemative evaluation was founded on the studies and practices from Jackson, Gillaspy, and Purc-Stephenson (2009) and

McDonald and Ho (2002). The PCA, CFA and SEM analysis will give a more detailed picture of the learner demographics, participation and course rating factors that are most conducive to fully online technology-rich learning models.

4. **Retrospective causal-comparative design**: This type of testing does not "allow for an explicit finding of causation but it does strongly suggest whether the mode of instruction had a direct impact on student retention" (Atchley, Wingenbach, & Akers, 2013, p. 3). The retrospective design strategy presumes the research has already taken place and from other variable influences it is used to determine a cause and effect relationship. The formulated hypotheses for the study compared learner completion data to the three learning environments, MOOCs, SPOCs, and online to determine causation and if there was any statistical significance. The hypothesis assumed: *H_0: There is no significant relationship between learner completions and the VET online learner profile variables for MOOCs, SPOCs, and online courses*. The VET online learner profile variable and hypotheses tests are listed below:

    H_1: Learner's primary reason for taking the course
    H_2: Learner's highest level of education
    H_3: Learner with English as their primary language
    H_4: Learner's place of residence
    H_5: Learner's gender
    H_6: Learner's age
    H_7: Where the learner has taken a previous online course
    H_8: Learner has previous online experience
    H_9: The course materials were relevant and had a positive impact on the learner
    H_{10}: The course activities had a positive impact on the learner
    H_{11}: Learner's overall course star rating
    H_{12}: Learner's preference for instructor involvement
    H_{13}: Learner's Week 1 quiz result
    H_{14}: Learner's Week 2 quiz result
    H_{15}: Learner's Week 3 quiz result
    H_{16}: Learner's Week 4 quiz result.

H_{17}: Learner's final assessment score for all weeks
H_{18}: Percentage of course completed by the learner
H_{19}: Learner's number of contributions to the week 1 discussion board
H_{20}: Total number of learner contributions to discussion boards
H_{21}: Learner's pre-course goals
H_{22}: Learner's pre-course experience
H_{23}: Learner's post-course goals
H_{24}: Learner's post-course experience

For the causal comparison, the first MOOC was used as the control group and the other consecutive MOOC/SPOC and online iterations were designated as the experimental groups for the purposes of determining causation. All hypotheses were two-tailed/directional and tested at 5% significance.

5. **Direct logistic regression modelling**: This was performed to assess the impact of each weekly activity and likelihood that MOOC, SPOC, and online learners would complete. The MOOC/SPOC data spanned 56 course pages. These included topic content pages, additional resources, discussion forums, and final assessment quiz pages for each of the four weeks as shown in Appendix I. A regression analysis was also conducted on online learner weekly progression with a total of eight activities recorded for each student over the four weeks. This comprised sourcing two occurrences of student online activity across weeks 1, 5, 10 and 15.

6. **Comparative analysis:** The final quantitative process for the study was to undertake a comparative analysis of categorical frequencies and descriptive statistics of all study variables for the learner groups: all, MOOC, completed MOOC, SPOC, completed SPOC and online. This was conducted to support data triangulation for other quantitative evaluations and to complement the retrospective causal-comparative design results. The comparative analysis outcomes of MOOC and completed MOOC learners were then used to build a VET MOOC learner profile to provide a

more detailed picture of the learners that frequent VET MOOCs. The variables that were analysed in this part of the evaluation included:

- A1 Primary reason for MOOC
- A2 Type of learner
- A3 Hours per week
- A4 Level of education
- A5 English primary language
- A6 Place living
- A7 Gender
- A8 Age
- A9 Hear about course
- A10 Previous online course
- A11 Previous online experience
- A12 Positive impact of course material
- A13 Positive impact of course activities
- A14 Course hours
- A15 Course recommendations
- A16 Course overall rating scale
- A17 Instructor involvement
- A18 Length canvas course
- A19 Discipline interest
- A20 Video interaction learning
- A21 Video interaction use
- A22 Video interaction enjoyment
- A23 PDF vs Video interaction
- A24 Pre-course learner goals
- A25 Pre-course learner experience
- A26 Post-course learner goals
- A27 Post-course learner experience
- A28 Participation in discussions
- A29 Learners completing course

Additional frequency comparisons were also conducted on the comparable categorical variables, EQ1:A16, EQ5:A12, EQ6:A13, from the CIT Subject Evaluation completed by online learners and the User Experience Survey undertaken by MOOC and SPOC learners (Table 10). This was carried out to contrast MOOC/SPOC and online learner perceptions on the sufficiency of the course materials, their ability to understand the resources and their overall course enjoyment.

3.3.5.2 Qualitative techniques

Four qualitative techniques were used to collect and generate data that would address the research questions from the open-ended survey responses supplied from the Welcome to Canvas survey (W), the User Experience survey

(U) and CIT Subject Evaluation (CE) (W:Q5, W:Q13, U:Q4, U:Q16, CE:Q13 & CEQ14).

Firstly, observational evaluations of responses provided by consenting participants were summarised through purposive qualitative sampling and the recurring variables coded as follows:

- Pre-course student goals: 1 Better understanding of the topic, 2 For personal interest, 3 Professional development.
- Pre-course learner experience: 1 Course delivery style, 2 Student learning experience, 3 Certification.
- Post-course student goals: 1 Enhanced career development opportunities, 2 Improved knowledge of the topic.
- Post-course learner experience: 1 Positive learning experience, 2 Variety of learning stimulus, 3 Instructor presence.

The selection of the recurring variables for this part of the qualitative evaluation was based on a paper by Paton (2017). Her action research study analysed the intrinsic and extrinsic attributes of pre- and post-learner goals and experiences to gain a better understanding of the motivational characteristics of VET MOOC learners as illustrated in Figure 11. The eleven characteristics identified by Paton (2017) have also been illuminated in the literature by scholars such as Barak et. al (2016), see for example pp. 53-58, and Jordan (2015), see for example pp. 353-355. They also found in MOOCs, intrinsic motivation can take the effect of knowledge improvement for professional development or personal interest and the extrinsic values are often associated with course design, certification, and instructor accessibility.

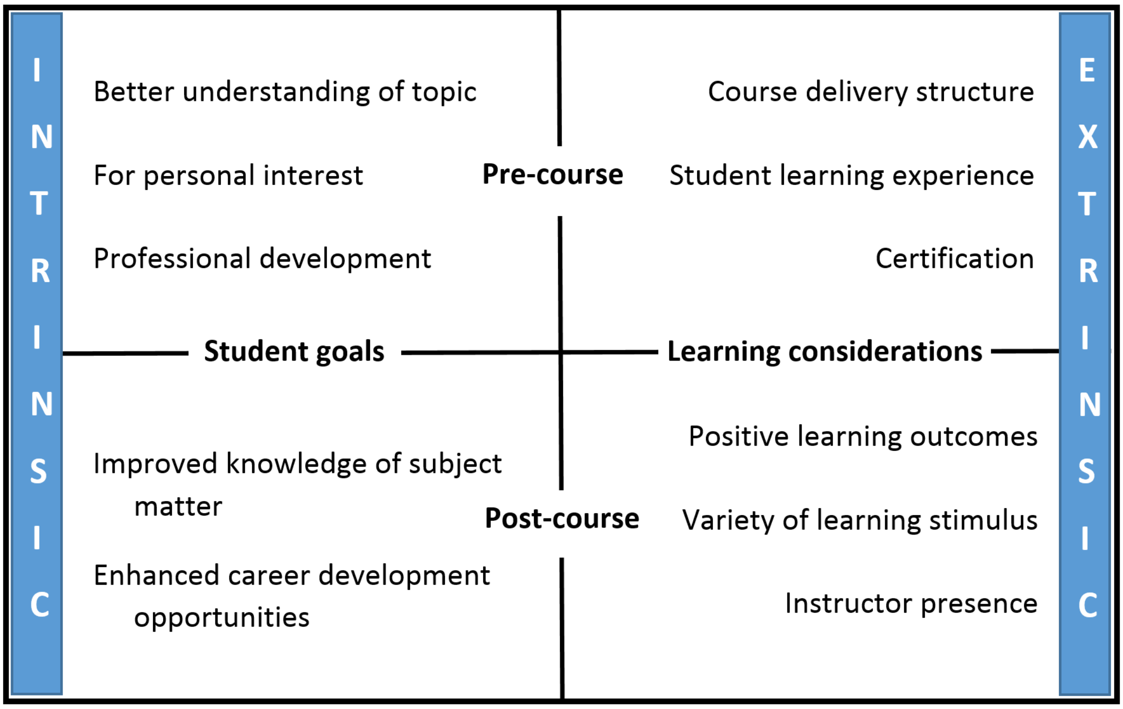


Figure 11. Paton (2017) Motivational characteristics of VET MOOC learners.

Secondly, a text analysis of the sixth, seventh, and eighth most important phrases from MOOC, SPOC, and online learner responses (W:Q5, WQ13, UQ4, UQ16, CE:Q13 & CEQ14) were evaluated using an online Text Analyser tool (available from online-utility.org/text/analyser.jsp) and guided by the methodological approach outlined by Paton, Fluck, and Scanlan (2018). By reviewing the word frequencies in this way, the researcher could gain a better understanding of the learner perceptions of the successes and challenges they had while studying a MOOC, SPOC, or online.

The third evaluation of MOOC, SPOC, and online learner comments (W:Q5, WQ13, UQ4, UQ16, CE:Q13 & CEQ14) was conducted through word cloud visualisations (available from wordclouds.com/). DePaolo and Wilkinson (2014) suggest word clouds produce a tangible representative of word frequencies by breaking down the text into component words. This information also provides a more detailed understanding of learner perceptions across learning modes.

The fourth and final analysis of qualitative comments (W:Q5, WQ13, UQ4, UQ16, CE:Q13 & CEQ14) was performed to broaden the researcher's understanding of the research inquiry by selecting participants who are best placed to help inform the research (Creswell, 2014). As the themes of the research were already defined, only the comments that supplemented the research themes (Figure 3) were selected. The coding of comments was particularly focused on learner perceptions but as most of the comments were positive, a mix of constructive comments and critical responses were identified for inclusion.

The four qualitative evaluations were synthesised from MOOC's 1–11, SPOC's 1–6, and online 1–6 learner comments. These contributed to the research by providing an instrumental understanding of learners' perceptions of their course experience. The recurring variables from the purposive sampling appraisal, text analysis of the sixth, seventh, and eighth most important phrases, word cloud visualisation frequencies and the verbatim learners' comments were then appraised against each research question.

3.4 Validity and reliability

Validity and reliability are imperative in the research process as it strengthens the accuracy of the findings. Validity and reliability have different interpretations in quantitative research than for a qualitative study. The procedural model that underpins the quantitative methodology in this study is critical scrutiny and presenting consistent data that are coherent to the research themes. Qualitative research reliability was established by ensuring the instrument's validity and past consistency.

Gibbs (2007) explains validity in quantitative research is a process of obtaining accurate research outcomes by conducting a range of statistical approaches. Reliability is a consistent and methodical approach when conducting the data analysis. The strengths of qualitative research are trustworthiness, authenticity, and credibility (Creswell & Miller, 2000) and the use of multiple approaches is a strategy that promotes better accuracy of research outcomes. The use of pre-designed surveys where responses are automatically stored in an electronic format reduces data transcription errors and provides the researcher with more confidence that the data samples accurately portray the research data (Andrews, Nonnecke, & Preece, 2003). Triangulation through the examination of multiple data sources "builds a coherent justification for themes" and this adds validity to the study (Creswell, 2014, p. 232). The blend of data sources and the mixed method design added to the validity and reliability of the quantitative investigation.

Qualitative research acknowledges the validity of data by initially establishing the quality of the survey instrument (Creswell, 2014) and the ability to demonstrate reliability based on past use (Borg & Gall, 2006). It was assumed that both the Welcome to Canvas Network Survey (Appendix D) and the User Experience Survey (Appendix E) were valid and reliable as they underwent expert review by the Canvas Network Team. As the Canvas platform is currently used by over 18 million teachers and learners, and more than 1200 institutions throughout the world, they are shown to be reliable qualitative instruments. The CIT Subject Evaluation (Appendix G) was initially developed via the CIT Evaluation Kit (CIT, 2001) and updated in line with ASQA (Australian Skills Quality Authority), Australian Quality Training Framework (AQTF) and 2015 Standards for Registered Training Providers requirements. CIT has been in operation as a provider of VET for just over 90 years and at the 2017 ASQA registration audit, CIT met all compliance obligations. Creswell (2009) identified qualitative validity as based on accurate findings from the view of the researcher, participants or the readers. The reliability measures in this study were found through multiple iterations of MOOCs, SPOCs, and online courses which have elicited a good sample size to enable a detailed research inquiry.

3.5 Ethical issues

The ethical responsibility to protect the welfare, dignity, and privacy of the participant was upheld by the researcher in this study. Prior to data collection, consent was granted by the Human Research Ethics Committee (Tasmania) Network and the CIT Research Committee for ethics approval and written consent was given to protect the privacy of the data. The participants who consented to the study did so on a voluntary basis and only learners over 18 years of age were included in the data collection. The invitation letter (Appendix C) provided the informed consent and included a withdrawal clause which affirmed that the learner could withdraw at any time from the study.

As this was a large population and large amounts of quantitative and qualitative data were obtained, all data were anonymised by transcoding the identifiable participant data to a unique research identifier. The assignment of research identifiers was undertaken by the CIT Forensic Science Department Administration Officer. The researcher was also the designated teacher for many of the courses evaluated in the study and had prior access to the data and participants. To strengthen confidentiality practices, the researcher did not access any grade information before the assessment results were released to students at the conclusion of each course. This prevented the researcher from inadvertently influencing the research process. As the analytical data and survey responses were extracted by a third party, namely the CIT Forensic Science Department Administration Officer, the participants' anonymity, confidentiality, and researcher objectivity were maintained.

In accordance with the data management plan which is shown in Appendix J, retained research data and/or primary materials, will be stored in long-term storage within the University of Tasmania or an appropriate data repository. The electronic and paper-based research documents supplied to the Chief Investigator will be securely stored on his password-secured computer and all hard copy data will be filed securely in a locked filing cabinet at the University of Tasmania to be preserved for five years following the publication of the thesis. Data that do not need to be retained will be securely destroyed. Electronic files will be deleted from the Chief Investigator's and Student Investigator's computer hard-drives, computer rubbish bins and organisational servers. Paper documents will be cross-cut shredded and put into a confidential recycle bin. CIT will not have access to the raw data or the re-identifiable codes obtained during the study.

3.6 Limitations

Both quantitative and qualitative components of the research had restrictions as the outcomes were dictated by the research questions, the students' responses, and the survey instruments. The research questions are a limit to a post-positivism research study as inferred statistics only detail a single reality (Golafshani, 2003). Additionally, the participants' responses were constrained to pre-designed options and question selections that were aligned to Canvas and CIT organisational requirements and not specifically developed for this research.

Investigator bias is a known consequence of qualitative research practices (Creswell, 2014) and, based on this researcher's experience, the features of connectivism theory exist to some degree in most VET courses. Additionally, the researcher had long-term involvement in the development and delivery, both as a teacher and an instructional designer on many of the units in which this study was undertaken. The possibility for learners to feel obligated to participate and to provide a particular perspective in their responses is acknowledged. Although prejudice could be an unconscious result (Baxter & Jack, 2008), steps were taken throughout the study, such as the researcher did not access the students' grades until the course concluded and a third party extracted student data and assigned research identifiers, to minimise the potential for bias and for positional power differentials to influence the outcomes of the research.

Action research has its own inadequacies in the research process as replication of results is specific to the participants and the setting in which the research is conducted (Hine, 2013). Validity and reliability of findings can be questionable, although efforts to reduce such biases are possible if the researcher has an open mind and thorough consideration is given to the research theories when interpreting data (Patton, 2002). The pragmatic process of triangulation and mixed-method designs founded on an action research approach as conducted in this study aid to strengthen the research outcomes and expand the discovery of truth by producing contradictory perspectives gained from the unexpected mixing of results (Bryman, 2006).

4 RESEARCH FINDINGS

4.1 Introduction

This chapter describes the research findings by using reflective practices (Kemmis et al., 2013) undertaken through an action research inquiry (Cohen et al., 2007; Hine, 2013). The study overview is modelled on a circular research design as illustrated in Figure 1. In conducting this study, the impacts and influences of engagement and retention were grounded on the literature and incorporated in the SLR engagement and retention tree (Figure 3). Specifically, this study establishes through quantitative and qualitative inquiry the MOOC students' course perceptions, engagement and retention factors, and aspects promoting student retention and student engagement relationships. This research also evaluated the perspectives, course progression, and participatory practices of learners studying in VET MOOCs, SPOCs, and online courses.

The quantitative analysis of all learner data was initially statistically explored to develop a baseline of MOOCs, SPOCs, and online completed and non-completed learners. Then a qualitative analysis of learner perceptions through purposive sampling, coding of the recurring variables of open-ended questions and text, and word cloud frequencies examinations are presented. The baselines could then be used for triangulation to complement the other analysis processes.

The remaining quantitative and qualitative investigations are laid out in terms of research questions and aligned to the themes, functional approaches and component categories (MOOC/SPOC: Table 5; online: Table 6). The statistical techniques such as comparative and descriptive data analysis, correlation testing, and retrospective casual-comparative design for hypothesis statements compared to MOOC 1 control group were scrutinised for the quantitative data. Direct logistic regression of learner progression and Structured Equation Modelling (SEM) was conducted on the quantitative data. The qualitative analysis of the individuals' comments through thematic analysis is also presented. The final evaluation for these findings was to build a VET MOOC learner profile to gain a detailed picture of VET learner attributes and the types of learner who frequent and complete VET MOOCs.

4.2 Quantitative analysis of baseline study data

The quantitative analysis of the baseline data for all learners encompassed two techniques to determine learner engagement and retention attributes. Initially, an evaluation of the categorical frequencies and descriptive statistics of the study data was performed on all study variables (MOOCs 1–11, SPOCs 1–6, and online 1–6). This enabled causal relationships between demographic, course, and participatory factors that impact learner engagement and retention to be identified. Additionally, a hypothesis-based retrospective causal-comparative design for statistical significance then details the effects of the MOOC 1 control group against the 24 study variables assessed.

4.2.1 Baseline analytics and comparisons for MOOC, SPOC, and online learner data

An evaluation of the categorical frequencies provided further outcomes and data triangulation to support the research inquiry questions. The categorical study variables for all delivery modes (MOOCs 1–11, SPOCs 1–6, online 1–6) were analysed (Appendix P) and the frequency output from the evaluation is displayed in Table 11.

Table 11. *Highest value frequencies for all delivery modes*

Variable		Value	n	Md	Freq	%
A1	Primary reason for MOOC	I enjoy learning about topics that interest me	683	2	284	41.6
A2	Type of learner	An active participant.	683	2	338	49.5
A3	Hours per week	Between 2 and 4 hours	683	2	241	35.3
A4	Level of education	Completed 4-year college degree	683	2	170	24.9
A5	English primary language	Yes	683	2	425	62.2
A6	Place living	Australia & South Pacific	683	2	254	37.2
A7	Gender	Male	683	2	400	58.6
A8	Age	25-34	683	2	192	28.1
A9	Hear about course	From a web search	683	2	155	22.7
A10	Previous online course	Other	683	2	136	19.9
A11	Previous online experience	Yes	683	2	553	81.0
A12	Positive impact of course material	Strongly Agree	308	2	143	46.4
A13	Positive impact of course activities	Agree	303	2	159	38.3
A14	Course hours student spends	Between 2 and 4 hours	302	2	116	38.4
A15	Course recommendations	Very Likely	300	2	127	42.3
A16	Course overall rating scale	Highest	300	2	144	48.0
A17	Instructor involvement	I like variety	299	2	164	54.8
A18	Length canvas course	4–6 weeks	300	2	129	43.0
A19	Discipline interest	Technology	300	2	136	45.3
A20	Video interaction for learning	Interactive video content deepened my understanding of course topics	288	2	70	24.3
A21	Video interaction usage	Easy to use	289	2	113	39.1
A22	Video interaction for enjoyment	I would enjoy using Video Interaction again	288	2	91	31.6
A23	PDF vs video interaction	I used both Interactive PDFs and Video Interaction	171	2	70	22.2
A24	Pre-course learner goals	Professional development	444	2	187	42.1
A25	Pre-course learner experience	Student learning experience	161	2	89	55.3
A26	Post-course learner goals	Improved knowledge of topic	136	2	84	61.8
A27	Post-course learner experience	Positive learning experience	237	2	162	68.4
A28	Participation in discussions	Yes	683	2	412	60.3
A29	Learners completed course	Yes	683	2	396	58.0

A descriptive analysis of all delivery modes (Appendix P) was also conducted for the assessment (B1–B6) and discussion (C1–C5) study variables. The findings provided the base-level learner distribution scores to enable further comparisons, as summarised in Table 12.

Table 12. *Assessment and discussion descriptive statistics for all delivery modes*

Variable	**n**	**Mean**	**Std. Dev**
B1 Week 1 Quiz Result	522	8.78	2.051
B2 Week 2 Quiz Result	455	9.06	2.018
B3 Week 3 Quiz Result	432	8.82	2.341
B4 Week 4 Quiz Result	414	8.68	2.442
B5 Weekly Final Assessment Score	683	23.65	16.852
B6 % Course Completed	683	0.69	0.401
C1 Week 1: Discussion Number	368	1.09	0.308
C2 Week 2: Discussion Number	284	1.05	0.391
C3 Week 3: Discussion Number	266	1.05	0.500
C4 Week 4: Discussion Number	256	1.05	0.435
C5 Total Discussions Number	683	2.10	2.348

The comparative analysis of frequencies and descriptive statistics for the other learner groups are documented as follows:

- MOOC in Appendix AA
- Completed MOOC learners in Appendix AB
- Completed SPOC and online in Appendix AC
- SPOC in Appendix AD
- Online in Appendix AE

4.2.2 Retrospective causal-comparative design baseline comparisons

A retrospective causal-comparative design was implemented as the study predictor effects had already occurred and this was a suitable method to determine whether one variable may have influenced another variable in the research process (Creswell, 2014). The causal-comparative analysis attempted to identify cause-effect relationships by testing 24 comparison variables (section 3.3.5.1.) between the MOOC 1 control group and the five learning modes: MOOC/SPOC/online, MOOC/SPOC, MOOC, SPOC, and online delivery. The hypotheses were based on the assumption: *H_0: There is no significant relationship between learner completions and the VET online learner profile variables for MOOCs, SPOCs, and online courses*.

The experimental action design commenced with a retrospective effect. For this effect, it was important to designate a control group from one of the MOOC iterations and MOOC 1 was selected as the “unit of study that did not receive the treatment whose effect is under investigation” (Lavrakas, 2008, p. 1). MOOC 1 received limited instructor interactions except for an initial welcome post and learners were supported with return emails for assistance requests (Appendix S). However, Lodico, Spaulding, and Voegtle (2010) warned that there are validity concerns that need to be addressed when using retrospective causal-comparative analysis such as data equality, randomisation, and manipulation. In this study, neither the group sizes nor the study variables were equal. Therefore, non-parametric Mann-Whitney U tests were employed to reduce validity threats. It should be noted that there was a median of 1 for the data variables in the MOOC 1 control group, SPOC, and online groups thereby providing a strong connection and data equality. The other groups resulted in a median of 2, therefore course comparisons were less reliable but still allowed for comparability. The research also incorporated the data from all consenting participants to reduce randomisation deficiencies and indiscriminate prejudice. The inability to manipulate the independent variables was considered an issue (Lodico et al., 2010), although Mann-Whitney U tests and confirmatory testing were conducted across and between learning modes to reduce data biases. Additionally, the effect size benchmarks (*r*) implemented in this investigation were classified as Small <.20, Medium <.30, Large <.50, and Very large <.70 as documented by Cohen (1988) and Rosenthal (1996) (as cited in Pallant, 2016).

Several Mann-Whitney U tests were conducted to compare the MOOC 1 control group against each learning mode. The tests revealed significant differences in 51 study variables across the learning groups as shown in Table 13.

Table 13. *Mann-Whitney U test results for learning mode comparisons*

Learning Mode	**Datasets**	**No. significant variables^**	**Test results**
Control group	MOOC 1		Appendix S
All*	MOOC 2–11, SPOC 1–6, Online 1–6	9	Appendix T
MOOC/SPOC*	MOOC 2–11, SPOC 1–6	9	Appendix U
MOOC*	MOOC 2–11	7	Appendix V
SPOC*	SPOC 1–6	15	Appendix W
Online*	Online 1–6	11	Appendix X

* Comparison variable: MOOC 1 dataset.
^ The mean difference is significant at the p<.05 level.

When the significant variables were compared to each learning mode, four hypotheses were found to be not significant for H_6 Learner's age, H_9 Course materials had a positive impact, H_{18} % course completed and H_{22} Learner's pre-course experience. However, the remaining 20 showed statistical significance as presented in Table 14.

Table 14. *Statistical significance and standardised proportional values of hypotheses tests for each learning mode*

Hypothesis test	Learning mode^	Standardised Proportional Values; Percent*
H_{23}: Learner's post-course goals	M/S/O, M/S, M, S, #	4:4; 80%
H_{24}: Learner's post-course experience	M/S/O, M/S, M, S, #	4:4; 80%
H_{4}: Learner's place of residence	M/S/O, M/S, S, O	4:5; 80%
H_{11}: Learner's overall course star rating	M/S/O, M/S, S, #	3:4; 80%
H_{13}: Learner's Week 1 quiz result	M/S/O, M/S, S, O	4:5; 80%
H_{15}: Learner's Week 3 quiz result	M/S/O, M/S, M, S	4:5; 80%
H_{16}: Learner's Week 4 quiz result	M/S/O, M/S, M, S	4:5; 80%
H_{20}: Total number of learner contributions to discussion boards	M/S/O, M/S, M, O	4:5; 80%
H_{3}: Learner with English as their primary language	M, S, O	3:5; 60%
H_{2}: Learner's highest level of education	M, O	2:5; 40%
H_{5}: Learner's gender	S, O	2:5; 40%
H_{7}: Where the learner has taken a previous online course	M/S/O, O	2:5; 40%
H_{8}: Learner has previous online experience	S, O	2:5; 40%
H_{14}: Learner's Week 2 quiz result	M/S, S	2:5; 40%
H_{17}: Learner's final assessment score for all weeks	S, O	2:5; 40%
H_{21}: Learner's pre-course goals	S, #	1:4; 20%
H_{10}: The course activities had a positive impact on the learner	S, #	1:4; 20%
H_{12}: Learner's preference for instructor involvement	S, #	1:4; 20%
H_{1}: Learner's primary reason for taking the course	O	1:5; 20%
H_{19}: Learner's number of contributions to the week 1 discussion board	O	1:5; 20%

Key: M/S/O: MOOC/SPOC/online; M/S: MOOC/SPOC; M: MOOC; S: SPOC; O: Online.
* The mean difference is significant at the 0.5 level.
^ Comparison variable: MOOC 1 dataset.
# Online learners did not supply a response and cannot be evaluated.
Effect designation colours: Small, Medium, Large, Very Large

4.3 Qualitative analysis of baseline study data

The qualitative approaches evaluated the open-ended responses of MOOC, SPOC, and online learners. Through observational sampling, coding and comparative analysis of students' pre- and post-course learning goals, text analysis evaluations, word cloud breakdowns and reviewing the perceptions of the learners presented in their own voice, the qualitative baselines were obtained. This enabled the perceptions of each student studying across the various learning modes to be detailed against each research question. The observational evaluations of learners' responses from MOOCs and SPOCs could not be replicated for online learners as comparable questions in the CIT Subject Evaluation were not available. An analysis was then undertaken of MOOC, SPOC, and online learner comments using the Text Analyser tool to appraise the top six, seven and eight phrases, along with a word cloud visualisation which dissects the comments into component words and frequencies. The final stage of the analysis assessed a range of direct quotes which delved deeper into the thoughts and feelings of learners.

4.3.1 Observational sampling and coding of learner pre- and post-course goals and experiences

An evaluation of learners' responses to the open-ended questions were conducted through purposive sampling and coding the recurring variables for MOOCs 1–11, SPOCs 1–6, and online 1–6 learners. The comments from Q5: How will this course meet your personal or professional goals and Q13: If you have any general feedback you'd like to provide, from the Welcome to Canvas survey (Appendix D) were coded as follows:

- A24 Pre-course Learner Goals: better understanding of topic, for personal interest, and professional development
- A25 Pre-course Learner Experience: course delivery style, student learning experience, and certification

Similarly, Q4: In what ways has this course helped you meet your personal or professional goals and Q16: If you'd like to provide any general feedback on the course, obtained from the User Experience survey (Appendix E) were coded against:

- A26 Post-course Learner Goals: enhanced career development opportunities and improved knowledge of topic

- A27 Post-course Learner Experience: positive learning experience, variety of learning stimulus and instructor presence

An evaluation of the pre-course and post-course learner variables provided a better understanding of the reasons MOOC and SPOC learners enrolled and their motivations to complete. Online learners were not assessed as they did not provide comments on these variables. The comparative analysis of each coded variable is presented in the findings as it corresponds to each research questions.

4.3.2 Text analyser evaluation of MOOC and SPOC comments

The second analysis re-evaluated the combined MOOC and SPOC learner comments (Q5 & Q13: Welcome to Canvas survey; Q4 & Q16: the User Experience survey) with Text Analyser (available from online-utility.org/text/analyser.jsp). The text analysis was used to determine the occurrences of word frequencies for the sixth, seventh, and eighth most important phrases identified by the learners (n=349). The top four comments for each phrase are detailed in Table 15.

Table 15. *Top phrases from MOOC and SPOC learner responses*

Phrase contains	**Phrase**	**Occurrences**
8 words	My level of understanding of biometric has greatly	5
	Thank the CIT for presenting this course in	4
	Of having certificate of achievement by submitting an	2
	Like you to extend the time limit to	2
7 words	Level of understanding of biometric has greatly	4
	Presenting this course in a very positive	2
	The opportunities of having certificate of achievement	2
	I thoroughly enjoyed the use of interactive	2
6 words	The use of interactive pdf's for	9
	Level of understanding of biometrics has	9
	Information builds upon for future learning	2
	A way that made it easily	2

4.3.3 Word cloud breakdown of MOOC and SPOC comments

To further evaluate MOOC and SPOC learner open comments (n=349), word cloud visualisations (available from wordclouds.com/) were produced. Word clouds break down the text into component words and then count the word frequencies to produce a tactile illustration of the data for useful qualitative analysis (DePaolo & Wilkinson, 2014). The outcomes are displayed in Figure 12.

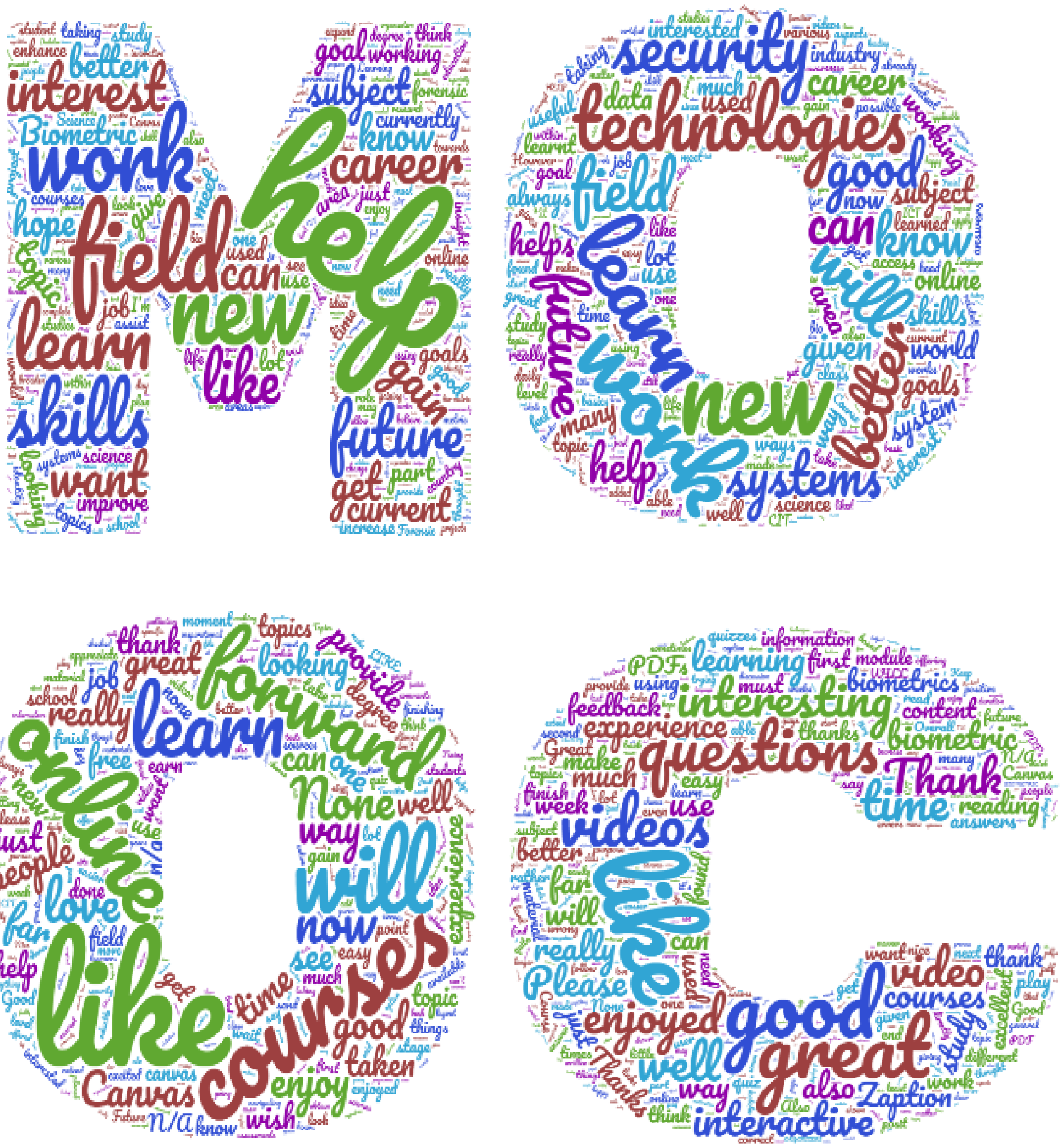


Figure 12. Word cloud visualisation for MOOC and SPOC learner responses.

The most common words and word frequencies that contributed to the word cloud visualisation are presented in Table 16.

Table 16. *Word frequencies for MOOC and SPOC learner responses*

Word Frequencies (589–77)		**Word Frequencies (65–31)**		**Word Frequencies (29–17)**		**Word Frequencies (16–10)**	
589	course	65	better	29	feedback	16	industry
447	biometrics	63	skills	29	opportunity	16	enhance
297	helpful	63	materials	29	life	16	free
284	knowledge	62	information	26	love	15	possible
257	learning	62	current	26	reading	15	relevant
216	work/job	61	career	25	presented	14	practical
190	understand	61	goal	23	important	14	done
175	interest	59	enjoy	23	easy	14	students
170	technology	56	time	23	idea	13	training
143	like	54	online	23	finish	13	identity
128	new	50	improve	23	problems/issues	13	nice
98	interactive	48	study	22	variety	13	broaden
96	field	48	certificate	22	answers	12	format
94	professional	43	identify	22	quiz	12	valuable
93	video	40	questions	20	insight	12	informative
91	good	39	experience	20	useful	12	curiosity
91	teacher	36	complete	19	assist	11	pace
84	security	36	develop	18	excellent	10	education
82	great	36	content	18	research	10	qualification
81	future	35	community	17	instructor	10	language
77	gain	31	pdf				

Further analysis of the word cloud visualisations and word frequencies for MOOC and SPOC are documented for each research inquiry question in the appropriate section of the research findings.

4.3.4 Text analyser evaluation of online comments

The same analysis was conducted on online learner open comments (n=25) from the CIT Subject Evaluation for Q13: What are the best aspects of the training (n=17) and Q14: What were the aspects of the training that could be improved (n=8). The Text Analyser tool provided the result of the top two comments from the top sixth, seventh, and eighth phrases as displayed in Table 17.

Table 17. *Top phrases from online learner responses*

Phrase contains:	Phrase	Occurrences
8 words	That there were quizzes every week for reinforcement	4
	To stay up to date with the readings	3
7 words	Liked that there were quizzes every week	6
	Acquired more knowledge and skills to allow	2
6 words	Up to date with the readings	4
	Knowledge and skills learned during MOOC	2

4.3.5 Word cloud breakdown of online comments

A word cloud visualisation was also implemented on online learner comments to gain a better understanding of their perceptions through word frequencies as presented in Figure 13.

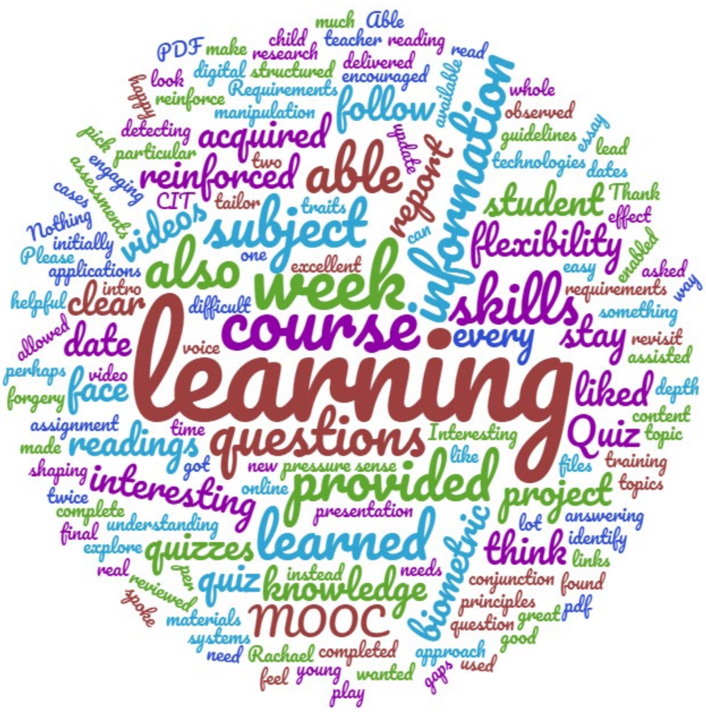


Figure 13. Word cloud visualisation for online learner responses.

The most common words and word frequencies that contributed to the word cloud visualisations are presented in Table 18.

Table 18. *Word frequencies for online learner responses*

Word Frequencies (12–4)		Word Frequencies (3)		Word Frequencies (2)	
12	learning	3	skills	2	training
10	quiz	3	pdf	2	topics
8	questions	3	MOOC	2	student
6	course	3	like	2	revisit
4	video	3	interesting	2	reviewed
4	teacher	3	completed	2	happy
4	requirements	3	clear	2	difficult
4	readings	3	biometric	2	content
4	information	3	knowledge		
4	helpful	3	flexibility		
4	assessments	3	reinforce		

Further analysis of the word cloud visualisations and word frequencies for online learners are documented for each research inquiry question in the appropriate section of the research findings.

4.3.6 MOOC, SPOC, and online learner course perceptions

The final analysis of the qualitative comments from MOOC and SPOC learners (n=349) and online learners (n=25) was performed to gauge learner perceptions of their course experiences. The majority of MOOC/SPOC learners found the learning was useful for obtaining knowledge in the field of biometrics and is reflective of this comment:

> *"This course will help me meet my personal and professional goal by offering me knowledge on a field of my interest, where I try to expand my knowledge and maybe pursue a career in the future."*

For online learners, the flexibility of learning was an important aspect which is signified by this remark:

> *"The flexibility of online learning. I have a young child and don't think I would have been able to complete this if delivered face to face."*

Further learner comments for each research inquiry question are documented in the appropriate section of the research findings.

4.4 Research Question 1: What are Vocational Education and Training students' perceptions of MOOC learning?

This research question specifically focuses on the learners' sense of community through the analysis of discussion participation across the four weekly discussion boards and social networking sites. The aim was to uncover if the learners' posting habits provided any insight into how social learning communities link to the learning process. The enticement of certification and academic pathways which lead the learner from a non-accredited MOOC into a full qualification is also explored. A critical evaluation is then conducted on the pre-course and post-course learner goals and experiences in order to gain further clarification as to why MOOC learners initially enrol and the aspects that motivate them to complete. The learners' course recommendations and overall course rating score are assessed and finally, a quantitative examination of learners' perceptions is presented.

4.4.1 Learners' sense of community through collaborative mechanisms

The analysis of learner perceptions to gain a critical understanding of the collaborative mechanisms they used and how social networking opportunities build a sense of community was undertaken. As the average posting participation for all learners was 60.3% (Md=2, n=683) (Table 11), a descriptive analysis of the four weekly discussion boards (C1–C4), total number of discussions (C5) and alternative discussion boards (C6–C9) were reviewed. The social networking opportunities for learners were evaluated for A17 Instructor involvement for the value, social learning. Then a Mann-Whitney U test of H_{19}: Learner's number of contributions to the week 1 discussion board and H_{20}: Total number of learner contributions to discussion boards, to determine any statistical significance against the MOOC 1 control group was conducted. Another quantitative analysis, using a Spearman Rho comparison of the total learner discussions and the percentage of course completed to further ratify the results was performed. Finally, two qualitative evaluations complemented the statistical findings with an evaluation of learner posts to the discussion boards and then a summary of comments from learners regarding their posting experiences.

4.4.1.1 Comparative analysis of discussion variables

A quantitative analysis of the descriptive statistics from the Canvas course analytics for each learner group was examined against the weekly discussions (C1–C4) and total number of discussions (C5). The total discussion number (C5) mean was highest for completed MOOC learners ($M=3.64$, $SD=2.5$, $n=288$) and completed SPOC learners ($M=3.45$, $SD=1.5$, $n=44$). The total discussion contributions for SPOC/online learners ($M=3.26$, $SD=1.7$, $n=47$) was still relatively strong when compared with all learners ($M=2.10$, $SD=2.3$, $n=683$). However, the results were inconclusive for the online group as the Apply Forensic Digital Imaging Techniques unit did not have a discussion activity and the Principles of Biometric Technologies had only one discussion forum which was optional for these learners. Another finding was the decline in discussion postings for completed learners was lower than for learners who did not complete:

- All learners 16% (Appendix P)
- MOOC learners 15% (Appendix AA)
- SPOC learners 11% (Appendix AD)
- Completed MOOC learners 5% (Appendix AB)
- Completed SPOC/online learners 9% (Appendix AC)

The results were indicative that learners who participated in discussions were more likely to complete and the act of posting and reading discussions seemed to promote stronger learner inclusion which was reflected in better completions.

4.4.1.2 Crosstab analysis of compulsory and non-compulsory discussions

A crosstab analysis on C5 Total discussions number was conducted to determine the flow of postings for the MOOC and SPOC groups that had compulsory and non-compulsory discussion board requirements as shown in Appendix Q. MOOCs 1, 2, 3, 4, 7, and 8 and SPOCs 1, 2, and 4 had compulsory discussion participation (n=370) with 69% of learners posting, whereas for non-compulsory discussions in MOOCs 5, 6, 9, 10, and 11 and SPOCs 3, 5, and 6, the participation (n=220) was still quite high with 54% of learners contributing to discussion forums. This outcome indicated that more than half of VET MOOC and SPOC learners posted even when the discussion forums were optional.

4.4.1.3 Evaluation of general discussion forums

The MOOC and SPOC groups had four general discussion boards (C6–C9) in addition to the four weekly discussion boards (C1–C4). The technical help forum (C6) was for learners who had technical issues with Canvas. Course Q&A (C7) was for specific questions about the course content. Introduce Yourself (C8) was where learners could leave a brief post about who they were and why they were doing the course. Finally, a general discussion board (C9) was for general chat with peers and the lecturer. The descriptive statistics for the posting habits of MOOC and SPOC learners are displayed in Table 19.

Table 19. *Descriptive statistics of general discussion board posts for MOOC and SPOC learners*

Variable	n	Min	Max	Mean	Std. Dev	Skewness		Kurtosis	
						Statistic	S. E.	Statistic	S. E.
C6 Technical Help Forum	31	1	3	1.26	.575	2.201	.421	4.003	.821
C7 Course Q&A	13	1	2	1.31	.480	.946	.616	-1.339	1.191
C8 Introduce Yourself	111	1	4	1.07	.349	6.310	.229	46.689	.455
C9 General Discussion	6	1	4	1.50	1.225	2.449	.845	6.000	1.741

The most commonly frequented discussion board was C8 Introduce Yourself (n=111). This forum was the initial communication method that learners, peers, and the instructor shared and was central to developing stronger community relationships. In comparison with the 294 average weekly discussions (C1–C4), the 111 learner posts in the Introduce Yourself forum, represents that 38% of learners were searching for social networking opportunities from the course.

4.4.1.4 Retrospective causal-comparative design for H_{19} and H_{20}

The comparative analysis of the MOOC 1 control group (H_{19}: Md=1, n=89, H_{20}: Md=1, n=121) and H_{19} Learner's number of contributions to the week 1 discussion board (Table 20) was significant for the online group only with a small effect noted.

Table 20. *Mann-Whitney U test results for H_{19} Learner's number of contributions to the week 1 discussion board*

Group	Md	n	U	z	p	r	Effect
MOOC 1 control group	1	89					
All	2	368	12375.5	-0.09	0.925	0.00	
MOOC/SPOC	2	338	10760.0	-0.93	0.353	0.05	
MOOC	2	299	9091.5	-0.84	0.402	0.05	
SPOC	1	128	1668.5	-0.75	0.456	0.07	
Online	1	119	1054.5	-2.83	0.005	0.26	Small

Note: Variable significance levels *p*<.05 are highlighted in green.

H_{20} Total number of learner contributions to discussion boards (Table 21) when compared to the control group, was significant for all, MOOC/SPOC, MOOC, and online groups.

Table 21. *Mann-Whitney U test results for H_{20} Total number of learner contributions to discussion boards*

Group	Md	n	U	z	p	r	Effect
MOOC 1 control group	1	212					
All	2	683	21673.0	-6.52	0.000	0.25	Small
MOOC/SPOC	2	590	19592.0	-5.44	0.000	0.22	Small
MOOC	2	543	16892.5	-5.90	0.000	0.25	Small
SPOC	1	168	2699.5	-0.53	0.598	0.04	
Online	1	214	2081	-8.17	0.000	0.56	Large

Note: Variable significance levels p<.05 are highlighted in green.

A large effect designation was seen for the online group and the other three groups displayed a small effect. As the online groups posting contributions were considerably low, this would account for the small effect in H_{19} and large effect in H_{20}. The significance, although small for all, MOOC/SPOC, MOOC, and online groups for H_{20}, is representative of more learners posting in these groups than in the MOOC 1 control group.

4.4.1.5 Spearman's Rho correlations for learner discussions and course completions

A Spearman's Rho test was conducted on the percentage of course completed (B6) against the total discussion number (C5) for MOOC learners and the results are displayed in Table 22.

Table 22. *Spearman's rank correlation for completed MOOC learners and total discussion*

Variables		**B6 % Course Completed**	**C5 Total Discussions Number**
B6 % Course Completed	*rho*	1.000	.517*
	p	.	.000
	n	683	683
C5 Total Discussions Number	*rho*	.517*	1.000
	p	.000	.
	n	683	683

* Correlation is significant at the $p<.01$ level (2-tailed).

There was a large positive correlation between B6 % course completed and C5 Total discussion number. This outcome shows that as learners progressed through the course, their posting contributions also increased.

4.4.1.6 Social networking opportunities

Learners were invited to join a private Facebook group specifically created for the MOOC, as presented in Figure 14. This provided another tool besides the four discussion forums for learners to communicate in and to nurture stronger social relationships (Kellogg et al., 2014). The group had over 85 people join since the MOOC was launched in 2015 but the postings were relatively slow with only one post a month. However, over 50 members on average viewed each post. Twitter was another opportunity for learners to get involved in the social chat. A Twitter group was not specifically created for the course but a well-subscribed biometric group was sourced (https://twitter.com/hashtag/biometrics?lang=en) and the link supplied. This source provided learners with a broader and more global level of biometric information, in comparison to the Facebook page where only course students were registered. As Twitter is a public site, there was no means by which information could be gained on the discussion contributions from students participating in this study but evaluating learner participation on public social networking sites would be a useful future study.

Figure 14. MOOC private Facebook page.

An evaluation was also conducted on the learners who had a stronger preference for social learning. The variable A17 Instructor involvement for the value I prefer peer-to-peer interactions with my classmates (social learning) was the choice for 14% of MOOC/SPOC (n=299, Appendix P), 5% for both MOOC (n=259, Appendix AA) and completed MOOC (n=218, Appendix AB) and 6% for SPOC learners (n=35, Appendix AD). However, if the percentage of learners for A17 Instructor involvement for the value I like variety (n=259) were included with learners who prefer peer involvement this outcome, then another 57% could be added to the proportion of MOOC/SPOC (14%) learners who require a social learning experience. Therefore, over 71% of learners in this study require some type of social connection to be incorporated into the course design.

4.4.1.7 Qualitative analysis of discussion board posts

The conversations that progressed across the MOOC and SPOC discussion forums were generally simple conversational responses that reflected the learners' understanding of the question. However, on occasions, a very detailed and informative answer was provided. For example, the third discussion board asks students: *If you could design your own multi-model system what biometric* *modalities would you choose and why?* Two responses of varying level are shown:

> *"It will depend upon the following factors such as: usability (how ease of use) and adaptability."*

> *"I will use different combinations of all of the biometric modalities. For example, one could capture a face image using 2 different extraction algorithms and 2 fingerprints using matching algorithms, to ensure more secure access for the individual and a system that is harder to spoof. This is because: 1. There are a number of factors that should be considered when designing a multi-modal system: The choice and number of biometric systems selected; accuracy of the trait; the matching operation; the population; the memory demands of the algorithms; and the security of multiple devices. 2. Attackers have more difficulty spoofing systems that use a combination of biometric traits and algorithms."*

Only one optional discussion board was available for online students in the Principles of Biometric Technologies unit. Just as with the MOOC/SPOC discussion posts, the quality of learner responses was quite varied. After viewing a YouTube presentation on biometric standards, the online learning group was asked to respond to the question, *"If biometric technologies follow international and national standards - Are security and privacy issues still a concern? Discuss"*. An example of a brief and detailed learner response is supplied:

> *"With anything, I believe that security and privacy issues are a concern and once a system becomes more complex so does the security and privacy. So, with biometrics increasingly becoming more complex, it could possibly be subject to spoofing. The rate of major companies getting hacked is also increasing. I think no matter the standards issues with security and privacy are going to be a concern."*

“The Australian Institute of Criminology publication relates to the public sentiment of biometrics, specifically those who have already been affected by identity theft. 96% of people who have been the victim of identity theft would adopt biometric technology, with older generations more likely to adopt.

The presentation highlights the perception vs the reality of existing password systems. If it hasn't failed for you, then it appears safer, so why fix what isn't broken. From a standards point of view, the design and use of biometric systems can be heavily regulated, but it is the public opinion that affects adoption. Thus, security and privacy will always be a concern. There is a persistent threat of hacking and privacy breaches trickling into the news, people are only naturally going to be hesitant.

The average citizen does not read through the list of 122 ISO standards to understand them. The sales pitch is just as important as the standards themselves. This would also be complicated by the rate of technological advance, which instills a level of skepticism, if not cynicism, surrounding the protection of people's rights and data. As quantum computing gains momentum in the next decade with ramifications for encryption, it may revolutionise system design and bolster public opinion. Security and privacy, in such a fast-changing industry, should always be of concern.”

4.4.1.8 Qualitative analysis of learner comments

The discussion forums were only minimally discussed in the comments from MOOC/SPOC students and none were recorded for online students. However, a positive and negative experience from learners who posted to the discussion boards is provided:

“There was a good level of interaction in the discussion forums from the instructor.”

> *"I didn't enjoy having to participate in the discussions, but I can understand why they're mandatory."*

4.4.2 Enticement of certification and academic pathways

The certification of course achievement from a MOOC provides the learner with a memento of their studies and can demonstrate the learner's aptitude to professional self-development (Radford et al., 2014). The enticement of a certificate can improve learner completions (Dillahunt et al., 2014) as the certificate enhances the individual's perception of improved career prospects. When micro-credential certification is affiliated with a selection of learning pathways that are affordable and focused on job outcomes, they provide another motivation for the learner to complete (Green et al., 2015; Hone & El Said, 2016; Hofer, Duggan, & Moellendick, 2018). The learners who completed a VET course (n=683) was 58%, when compared to non-completers (n=396). This illustrates that more than half of the combined learners successfully completed their courses.

4.4.2.1 Comparative analysis of pre-course learner goals: certification frequencies

Learning for most VET students is the pursuit of knowledge for a professional development application with certification being an important aspect of this. An evaluation of learners' responses to the pre-course Welcome to Canvas Survey open-ended questions was conducted for A25 Pre-course learner experience and, through purposive sampling, the recurring variables were coded as course delivery style, student learning experience, and certification. Certification was an important factor for all learner groups with around 17% of learners expressing that gaining an award on course success was a conditional factor on their enrolment, as presented in Table 23.

Table 23. *Frequency values for A25 Pre-course learner experience: Certification*

Group	n	Frequency	%
MOOC/SPOC	161	27	16.8
MOOC	135	22	16.3
Completed MOOC	86	13	15.1
SPOC	26	5	19.2

4.4.2.2 Qualitative analysis of learner comments

An analysis of the text and word cloud results for certification and pathways revealed MOOC/SPOC (n=349) frequencies for the word *certificate* was represented in 8-word and 7-word phrases with 2 occurrences noted for each (Table 15). The word cloud frequencies also found 48 occurrences of the word *certificate* spread across learners' comments (Table 16). MOOC and SPOC learners perceived course certification as a positive aspect on successful course completion, and consistent with these students' insights:

> *"Looking forward to more free online certification courses to learn and gaining more knowledge."*

> *"I am interested in further study in biometrics - I felt this course was a good platform to start."*

However, one learner felt that certification needed to be more globally recognised and responded:

> *"I enjoy the online learning experience, though feel it needs to be more stably recognised as a legitimate source of being a degree/certificate to aid people in getting a job or starting a career."*

This statement, although perplexing as the CIT offers an educational pathway from MOOC to qualification (Figure 9), is representative that digital badges and micro-credentials need further exploration (Hofer et al., 2018). Better MOOC completion rates were achieved when learners had the opportunity to gain formal certification and the option of further study was available for ongoing development (Green et al., 2015; Hone & El Said, 2016).

4.4.3 Desire and influence of free learning

An evaluation of the open-ended questions from the pre-course Welcome to Canvas survey and post-course the Canvas Learner Experience survey was conducted through purposive sampling and coding of the recurring variables (Appendix P). The values for the recurring variables for:

- A24 Pre-course learner goals: better understanding of topic, for personal interest, professional development
- A25 Pre-course learner experience: course delivery style, student learning experience, certification
- A26 Post-course learner goals: enhanced career development, opportunities for improved knowledge of topic
- A27 Post-course learner experience: positive learning experience, variety of e-Learning stimulus, instructor presence

4.4.3.1 Comparative analysis of pre-course learner goals and post-course learner experience

An evaluation of the pre-course (A24, A25) and post-course (A26, A27) learner variables was undertaken to understand the reasons MOOC and SPOC learners enrolled and their motivations to complete, as displayed in Table 24. Online learners were not assessed as they did not provide comments specific to these variables.

Table 24. *Highest frequency values for pre- and post-course learner goals and experience for MOOC and SPOC learners*

Variable		Value	n	Frequency	%
A24	Pre-course Learner Goals	Professional development	444	187	42.1
A25	Pre-course Learner Experience	Student learning experience	161	89	55.3
A26	Post-course Learner Goals	Improved knowledge of topic	136	84	61.8
A27	Post-course Learner Experience	Positive learning experience	237	162	68.4

Professional development and the students' learning experience were the top pre-course ideals for learners and post-course learners wanted to improve topic knowledge which was achieved through a positive learning experience.

To further explore these perceptions, an evaluation of the categorical frequencies for MOOC/SPOC, MOOC, completed MOOC, and SPOC learner groups based in their most common responses for A24 Pre-course learner goals was conducted to determine the main reasons the learner enrolled. The most frequent value was *professional development* across the four groups, as shown in Table 25.

Table 25. *Frequency values for A24 Pre-course learner goals*

Group	Value	n	Frequency	%
MOOC/SPOC	Better understanding of topic	444	125	28.2
MOOC		406	118	29.1
Completed MOOC		223	69	30.9
SPOC		38	7	18.4
MOOC/SPOC	For personal interest	444	132	29.7
MOOC		406	127	31.3
Completed MOOC		223	48	21.5
SPOC		38	5	13.2
MOOC/SPOC	Professional development	444	187	42.1
MOOC		406	161	39.7
Completed MOOC		223	106	47.5
SPOC		38	26	68.4

However, the second most frequent goal was taking the course *for personal interest*. This was considered a compelling reason why MOOC and SPOC learners enrolled in the first instance, whereas the second highest frequency value for completed MOOC and SPOC learners was to gain a *better understanding of the topic* as their main enrolment motivation. For professional development, although it was the strongest reason students were retained in a MOOC, the key enrolment motivator was to gain a better understanding of the topic.

The pre-course learner experience (A25) identified the aspects that were most important to the learner when they commenced the course. The *student learning experience* was over 50% more important to MOOC/SPOC, SPOC and completed MOOC learners. However, 46% of SPOC learners perceived the *course delivery style* was more important to them. Certification on course completion was also a consideration for learners, with 17% indicating this was an attribute to their learning, as displayed in Table 26.

Table 26. *Frequency values for A25 Pre-course learner experience*

Group	Value	n	Frequency	%
MOOC/SPOC	Course delivery style	161	45	28.0
MOOC		135	33	24.4
Completed MOOC		86	19	22.1
SPOC		26	12	46.2
MOOC/SPOC	Student learning experience	161	89	55.3
MOOC		135	80	59.3
Completed MOOC		86	54	62.8
SPOC		26	9	34.6
MOOC/SPOC	Certification	161	27	16.8
MOOC		135	22	16.3
Completed MOOC		86	13	15.1
SPOC		26	5	19.2

The post-course learner goals (A26) identified the main goals that were most important to the learner on course completion. The indication was that *improved knowledge of the topic* was over 63% more important for all groups when compared with 37% for *enhanced career development opportunities*, as presented in Table 27.

Table 27. *Frequency values for A26 Post-course learner goals*

Group	Value	n	Frequency	%
MOOC/SPOC	Enhanced career development	136	52	38.2
MOOC	opportunities	117	46	39.3
Completed MOOC		94	36	38.3
SPOC		19	6	31.6
MOOC/SPOC	Improved knowledge of topic	136	84	61.8
MOOC		117	71	60.7
Completed MOOC		94	58	61.7
SPOC		19	13	68.4

The post-course learner experience (A27) variable revealed the learners' perceptions of their course experiences and the factors most important to them post-course. The outcome for MOOC/SPOC, MOOC, and completed MOOC was over 63% selected a *positive learning experience,* although for SPOC learners, a *variety of learning stimulus* was equally important. Instructor's presence was a notably important aspect for all learners and over 10% indicated the instructor was a necessary component for a positive learning experience. The frequency values are displayed in Table 28.

Table 28. *Frequency values for A27 Post-course learner experience*

Group	Value	n	Frequency	%
MOOC/SPOC	Positive learning experience	237	162	68.4
MOOC		218	154	70.6
Completed MOOC		170	123	72.4
SPOC		19	8	42.1
MOOC/SPOC	Variety of learning stimulus	237	51	21.5
MOOC		218	42	19.3
Completed MOOC		170	30	17.6
SPOC		19	9	47.4
MOOC/SPOC	Instructor presence	237	25	10.1
MOOC		218	22	10.1
Completed MOOC		170	17	10.0
SPOC		19	2	10.5

4.4.3.2 Retrospective causal-comparative design for pre- and post-course perceptions (H_{21} - H_{24})

Several Mann-Whitney U tests were performed on H_{21}: Learner’s pre-course goals, H_{22}: Learner’s pre-course experience, H_{23}: Learner’s post-course goals and H_{24}: Learner’s post-course experience and how they compared with the MOOC 1 control group. Online learners were not included in this analysis as they did not supply responses for these variables.

There was statistical significance found in the pre-course hypothesis test H_{21} (Table 29) for the SPOC group where learners (n=38, 68%) commonly selected professional development but only a small effect was indicated. However, there was no statistical significance noted for H_{22} (Table 30).

Table 29. *Mann-Whitney U test results for H_{21} Learner’s pre-course goals*

Group	Md	n	U	z	p	r	Effect
MOOC 1 control group	1	110					
MOOC/SPOC	2	444	17064.0	-1.19	0.232	0.06	
MOOC	2	406	15574.5	-0.71	0.475	0.04	
SPOC	1	148	1489.5	-2.8	0.004	0.23	Small

Note: Variable significance levels *p*<.05 are highlighted in green.

Table 30. *Mann-Whitney U test results for H_{22} Learner’s pre-course experience*

Group	Md	n	U	z	p	r	Effect
MOOC 1 control group	1	21					
MOOC/SPOC	2	161	1308.0	-0.91	0.365	0.07	
MOOC	2	135	1098.0	-0.68	0.494	0.06	
SPOC	1	47	210.0	-1.4	0.139	0.20	

For the post-course hypotheses tests H_{23} (Table 31) or H_{24} (Table 32), statistical significance was found across both tests and the three groups. This implies that improved knowledge of the topic and a positive learning experience are factors that strongly influence learning.

Table 31. *Mann-Whitney U test results for H_{23} Learner's post-course goals*

Group	Md	n	U	z	p	r	Effect
MOOC 1 control group	1	21					
MOOC/SPOC	2	136	733.5	-3.39	0.001	0.29	Small
MOOC	2	117	613.5	-3.31	0.001	0.31	Medium
SPOC	1	40	120.0	-2.4	0.013	0.38	Medium

Note: Variable significance levels *p*<.05 are highlighted in green.

Table 32. *Mann-Whitney U test results for H_{24} Learner's post-course experience*

Group	Md	n	U	z	p	r	Effect
MOOC 1 control group	1	69					
MOOC/SPOC	2	237	4423.5	-3.50	0.000	0.23	Small
MOOC	2	218	4040.5	-3.18	0.001	0.22	Small
SPOC	1	88	383.0	-3.7	0.000	0.39	Medium

Note: Variable significance levels *p*<.05 are highlighted in green.

4.4.3.3 Frequency analysis of learners' course perceptions and retrospective causal-comparative design for H_{11} course ratings

An additional evaluation to understand learners' perceptions post-course by analysing A15 Course recommendations and A16 Course overall rating scale was conducted. The value choices for A15 was a rating scale from 1:Not likely to 10:Very likely and A16 was also a rating scale from 1:Lowest to 5:Highest. The highest frequency values for A15 and A16 for all, MOOC, completed MOOC, and SPOC learners are presented in Table 33 and Table 34, respectively.

Table 33. *Highest frequency values for A15 Course recommendations*

Group	Value	n	Frequency	%
All	10 Very likely	300	127	42.3
MOOC	10 Very likely	260	122	46.9
Completed MOOC	10 Very likely	219	104	47.5
SPOC	8 out of 10	35	10	21.3

Table 34. *Frequency values for A16 Course overall rating scale*

Group	Value	n	Frequency	%
All	5 Highest	300	144	48.0
MOOC	5 Highest	260	136	52.3
Completed MOOC	5 Highest	219	119	54.3
SPOC	4 out of 5	35	20	42.6

The top recommendation of *very likely* and highest course rating of 5 out of 5 was given on average by 49% of course participants, although SPOC learners were not as forthcoming with their highest recommendation rating 8 out of 10 (21.3%) and overall course rating 4 out of 5 (42.6%).

To further explore the overall course rating, a Mann-Whitney U test for H_{11} Learner's overall course star rating was conducted against the MOOC 1 control group, as displayed in Table 35.

Table 35. *Mann-Whitney U test results for H_{11} Learner's overall course star rating*

Group	Md	n	U	z	p	r	Effect
MOOC 1 control group	1	68					
All	2	295	6563.5	-2.06	0.039	0.12	Small
MOOC	2	260	5843.0	-1.43	0.153	0.09	
SPOC	1	103	720.5	-3.62	0.000	0.36	Medium

Note: Variable significance levels p<.05 are highlighted in green.

The results were found to be significant with a small effect for all learners which suggests the course was perceived as beneficial. As SPOC students were required to transition between two different learning platforms (Canvas and eLearn), the medium effect could have been indicative of the confusion and difficulties encountered by this group. There was also a notable difference in the course and platform quality with eLearn harder to navigate than Canvas and this could have contributed to the medium effect seen in H_{11}.

4.4.3.4 Qualitative analysis of learners' perceptions of free learning

An appraisal of the Text Analyser results (section 4.3.2) and word cloud frequencies (section 4.3.3) for MOOC and SPOC learners (n=349) was evaluated from the pre- and post-Canvas surveys (A24–A27). The associated themes were explored for free, learning experience, professional development, work or job opportunities and course enjoyment or frustration. The text analysis presented several phrases that had commonality with 8, 7 and 6 words, these were: *My level of understanding of biometric has greatly* (5), *presenting this course in a very positive* (2) and *information builds upon for future learning* (2). The word cloud of learner responses ranked in the top nine frequencies for MOOC and SPOC learners included *knowledge* (284), *learning* (257), *work/job* (216), *like* (143), *good* (91), *great* (82), *enjoy* (59), *excellent* (18), and *free* (16).

The specific comments that detailed the learners' thoughts on the course were scrutinised for the equivalent research themes (Figure 3). The development of professional skills for a future career path was a key influence for learners. Several learners spoke of their experiences:

> *"I'm a computer applications graduate looking for a professional job. In the meantime, I want to learn new things about technology so that I can be more updated and improve my technical knowledge and skills."*

> *"I am completing a degree in Forensic Science and Biometrics is a highly important component to the broader forensic industry. This course is a component of a biometrics qualification, which I intend to apply to my career more broadly both in terms of application of theory and familiarity with using biometric data within a legal context."*

> *"The knowledge that I have gained by doing this course has helped build my confidence to apply for different roles within the subject."*

The free attribute was another positive aspect of completing the MOOC, with statements from learners consistent with these insights:

> *"Doing it for free and at my own time and anywhere seems to be a very good opportunity that is very hard to resist."*
>
> *"However, what has put me off doing a course such as this has been cost, I am truly grateful for this one."*

4.4.4 Summary for Research Question 1

The learners' perceptions of studying VET MOOCs were evaluated by analysing student contributions to weekly discussion boards, social networking sites and their attitudes to course certification and free MOOCs.

The average posting participation was 60% for all learners but there was a 10% decline in discussion contributions across the four weeks. Completed learners, on the other hand, contributed more frequently with 74% of learners posting to discussion forums, although a 7% decline was noted across the four weeks. When the discussion boards were compulsory, the Spearman's Rho tests revealed 69% of learners contributed whereas 54% of learners posted when discussion forums were optional. The most frequented forum was Introduce Yourself which indicated social networking was an important tool that enabled learners to better engage. The Facebook page provided another social networking option but only 8% of learners subscribed to this site. The Mann-Whitney U test for H_{20} Total number of learner contributions to discussion boards was statistically significant for all groups except SPOC with over 71% of learners contributing to one or more of the social communication tools available. The qualitative analysis of discussion posts for all groups showed most learners only provided simple reflective responses. However, some learners did supply quite comprehensive answers. Learners found the discussion forums allowed them to interact with their peers and the instructor but there was a preference for optional participation.

Learners experienced MOOCs as a good way to learn about a new topic and certification was perceived by 17% of learners as a positive course motivator.

Free learning was specifically identified as the initial reason for undertaking the course and offering further pathways from MOOC to a formal qualification was an important retention strategy that improved overall completions. However, there was one learner concerned that the MOOC certificate was not globally recognised. Pre-course, 42% of learners enrolled for professional development purposes and 55% considered the student learning experience was a significant aspect to their ongoing engagement. No statistical significance was found in the Mann-Whitney U testing for H_{21}: Learner's pre-course goals and H_{22}: Learner's pre-course experience except for SPOC was statistically significant (p<.05) with a small effect for professional development. Post-course, 62% of learners wanted improved topic knowledge and 68% required a positive learning experience. For 48% of SPOC learners, a variety of learning stimulus was important for their ongoing engagement. The Mann-Whitney U tests confirmed statistical significance (p<.05) for all groups on H_{23}: Learner's post-course goals and H_{24}: Learner's post-course experience.

For the course recommendations, 49% of learners gave the highest rating as did 43% on the overall course rating scale. This was corroborated by a Mann-Whitney U analysis on H_{11} Learner's overall course star rating, as it showed statistical significance (p<.05) for all learners with a small effect. However, SPOC learners were less complimentary with 21% giving the second highest recommendation which suggests the movement between the Canvas and eLearn learning platforms was somewhat confusing for these learners. The statistical significance (p<.05) and medium effect for H_{11} in the SPOC group supports this assumption. Overall, learners expressed satisfaction as the learning experience was beneficial for 81% in gaining topic knowledge and 62% for improved job prospects.

4.5 Research Question 2: What are the factors identified in student engagement and retention for VET MOOCs?

MOOC completion rates are commonly recorded as being between 12% and 36% (Dillahunt et al., 2014; Jordan, 2014; Perna et al., 2014). In comparison, VET MOOCs have been found to have an average completion of 35% (Paton, Scanlan, et al., 2018). This research question explored the factors identified from the literature analysis that affected student engagement and retention. These factors were:

- Instructor's commitment to globally contextualised communication
- Learner participation coupled with engagement patterns
- Impact of delivery preferences on engagement and retention

4.5.1 Instructor's commitment to globally contextualised communication

The instructor's behaviour can influence learner engagement and retention in online courses. Therefore, a detailed analysis of instructor involvement (A17) to determine the variety of preferred involvement sources was undertaken. A Mann-Whitney U test for H_{12} Learner's preference for instructor involvement was also conducted to ascertain any statistical significance against the MOOC 1 control group. Then a qualitative evaluation of the word cloud frequencies and learner comments was undertaken to further examine learner perceptions of the instructor.

4.5.1.1 Comparative analysis of instructor variables

An evaluation of learners' preferences for instructor interaction was conducted on the variable A17 Instructor involvement. A variety of involvement sources were preferred by 32% of learners and included self-learning, peer-learning, and instructor-based interactions. The frequency outcomes are displayed in Table 36.

Table 36. *Frequency values for A17 Instructor involvement*

Group	Value	n	Frequency	%
All	I like to learn on my own	299	70	10.2
MOOC		259	59	22.8
Completed MOOC		218	47	16.3
SPOC		35	11	23.4
All	I prefer peer-to-peer interactions	299	14	2.0
MOOC		259	12	4.6
Completed MOOC		218	27	9.4
SPOC		35	2	4.3
All	I prefer to communicate only with the instructor	299	41	6.0
MOOC		259	31	12.0
Completed MOOC		219	27	9.4
SPOC		35	7	14.9
All	I like variety	299	164	24.0
MOOC		259	147	27.1
Completed MOOC		219	125	43.4
SPOC		35	15	31.9
All	I do not interact with my instructor	299	10	1.5
MOOC		259	10	1.8
Completed MOOC		219	9	3.1
SPOC		35	0	0

Completed MOOC learners were most excited about interaction variety, with 43% of learners choosing this option, SPOC 31.9%, MOOC 27.1%, and all learners 24%. The frequency proportions for the other values were 18% self-learning followed by 10% instructor communication, then 5% social learning and finally only 2% of learners wanted no instructor interactions at all. This indicates that a variety of communication modes should be incorporated in the MOOCs' design, including avenues for learners to access the instructor and to participate in peer interaction opportunities for learners who like to socialise. There should also be a consideration for the less social learners and optional discussion boards can benefit the 3% of students who do not want to interact with others.

When these findings were compared to A27 Post-course learner experience for instructor presence (Table 28), the requirements for learners to see the instructor as a visible and accessible entity was also around 10% for MOOC/SPOC (n=237), MOOC (n=218), Completed MOOC (n=170) and SPOC (n=19).

4.5.1.2 Retrospective causal-comparative design for H_{12} Learner's preference for instructor involvement

A Mann-Whitney U comparative analysis was performed on the MOOC 1 control group (H12: Md=1, n=68) and H_{12} Learner's preference for instructor involvement, to determine if there was any statistical significance across the five groups, as presented in Table 37.

Table 37. *Mann-Whitney U test results for H_{12} Learner's preference: instructor involvement*

Group	**Md**	**n**	**U**	**z**	**p**	**r**	**Effect**
MOOC 1 control group	1	68					
All	2	299	7228.0	-1.10	0.270	0.06	
MOOC/SPOC	2	294	7078.0	-1.09	0.275	0.06	
MOOC	2	259	6161.5	-0.70	0.484	0.04	
SPOC	1	30	849.5	-5.78	0.000	1.06	Very Large
Online	1	73	130.0	-0.17	0.863	0.02	

Note: Variable significance levels $p<.05$ are highlighted in green.

The test found no significant results for any of the groups except SPOC which showed a very large effect. This is indicative that no SPOC learner selected the option and did not interact with the instructor as their main mode of communication was through eLearn messages and not the MOOC or Canvas messaging systems.

4.5.1.3 Qualitative analysis on learners' perceptions of instructor

The Text Analyser results uncovered no phrases that made specific comment on the instructor (Table 15). However, the word cloud frequencies (Table 16) for MOOC/SPOC (n=349) found 91 occurrences of the word *teacher* and 17 occasions where the word *instructor* was used. The instructor was also regularly thanked for the course, but little feedback was forthcoming from students on the instructor's communication style. The remarks from learners were mostly positive with very few negative statements provided. On one occasion, a student asked if the instructor was really an artificial intelligence robot. These remarks are exemplified by the following comments:

> "*I must say when the instructor is talking about the topics and explaining it, it helps me to have a better understanding ...*"

> *"The teacher was obviously taking great pains to be clear but, as a native English speaker, I found the lectures better at 1.25x."*

> *"Are you really replying or are you AI?"*

These examples are reflective of the learners' perceptions towards the instructor and although only 10% of students wanted to interact with the instructor, the belief that a real person was overseeing the course was particularly important for the learners in this study.

4.5.2 Learner participation coupled with engagement patterns

The learner participation factors evaluated in this section were based on four classifications: an observer, a drop-in, a passive participant and an active participant. The learner self-selected their learner type (A2 Type of learner) in the pre-course Welcome to Canvas survey and this was then compared to the percentage of the course the learner completed (B6 % course completed) to gauge if there was any correlation between the two variables. A direct logic regression was also performed on the learner's progression activity to find any statistical significance in learner completion and non-completion patterns. Then further modelling of engagement and retention pattern to estimate causal relationships between the study variables was conducted.

4.5.2.1 Analysis of learner classifications against completions

The learner was asked to nominate their classification type in the pre-course 'Welcome to Canvas' survey (A2 Type of learner). A cross-tabulation was conducted on learners who completed and those who did not complete, as displayed in Table 38.

Table 38. *Frequency of learner classifications types*

Learner classification	**Course completed**		**Total**
	No	Yes	
An observer	22	16	38
A drop-in	16	14	30
A passive participant	95	86	181
An active participant	122	216	338
No response	32	64	96
Totals	287	396	683

Approximately 1 in 2 active participants (n=338) and ¾ of observers (n=38) identified their correct classification. Passive (n=181) and drop-in (n=30) participants could accurately identify their classification 90% of the time. Across all learners, 71% knew what learner classification they were even before commencing the MOOC.

A second analysis was conducted on learner classification (A2 Type of learner) and the percentage of the course completed (B6 % course completed) to determine if there were any relationships between self-selected learner classifications and the amount of the course the learner completed, as presented in Figure 15.

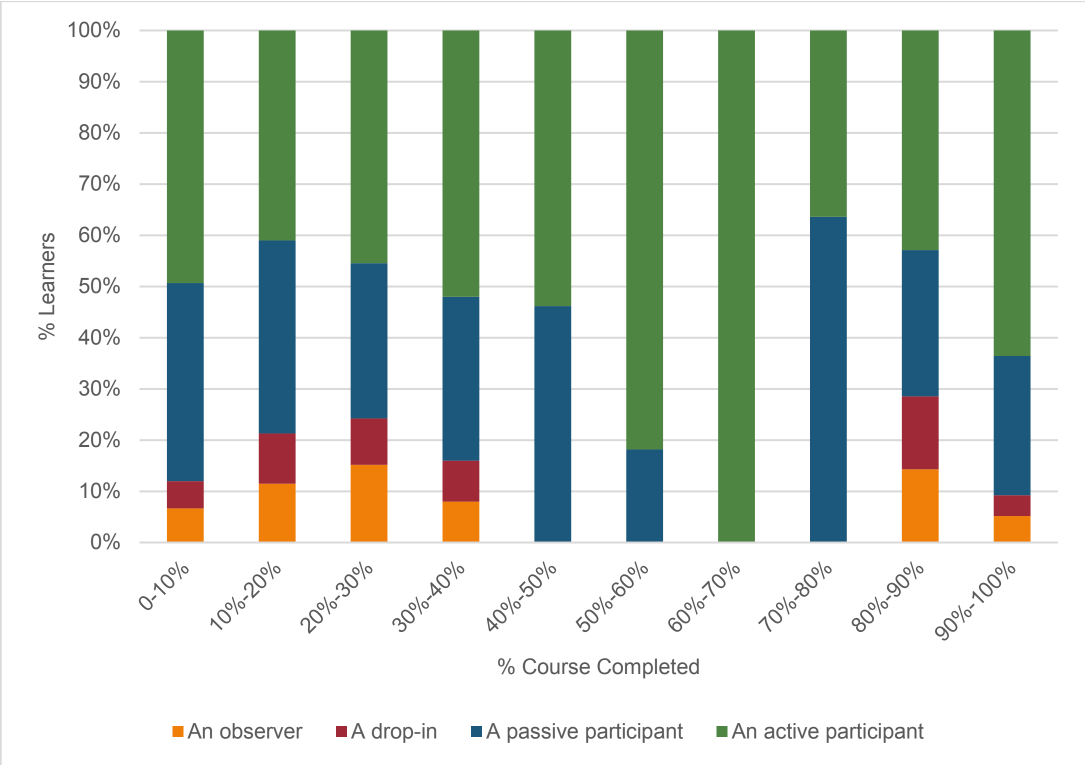


Figure 15. Percentage of course completed for learner classification types.

The stacked column chart shows that active participants had a steady flow of activity for the first 60% of the course and then activity slowed until the last 90%–100% of the course where activity again ramped up. The passive learner also showed a similar flow of activity for the first 40% of the course and then dropped off before improving in the last 10%. Both observers and drop-in learners had varied activity progression, but most activities were completed in the first 20% and last 10% of the course.

4.5.2.2 Direct logistic regression for learner progression

The initial frequency analysis for learner progression over 56 course pages from MOOCs and SPOCs and 8 course pages from online course learners was conducted (Appendix Y) and the weekly progression of learners who completed the course is presented in Figure 16.

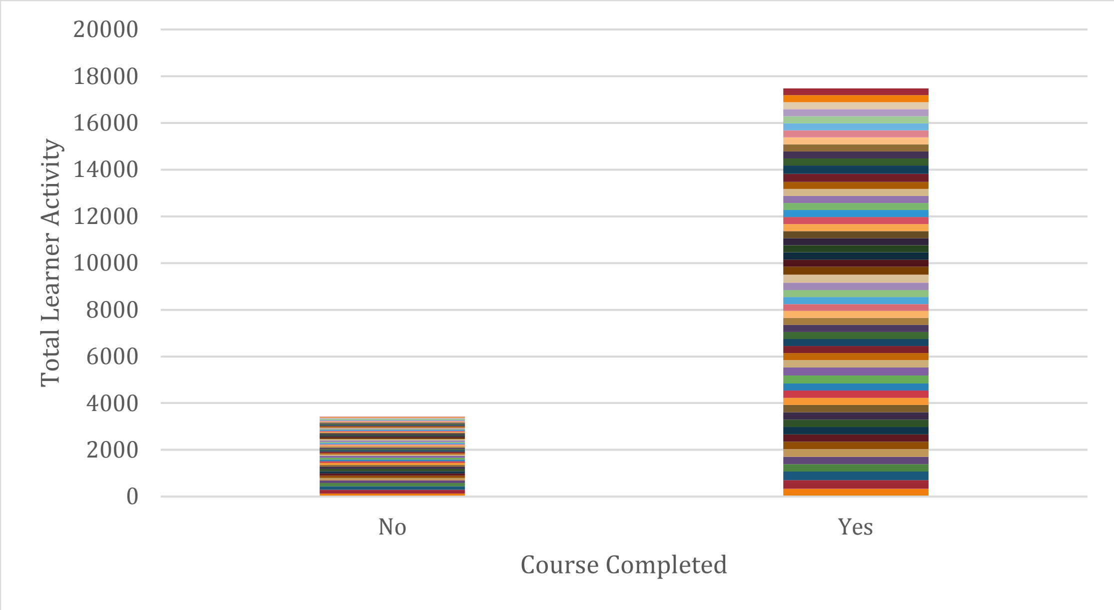


Figure 16. Weekly activity progression for completers and non-completers.

Activity completion was 69% higher in learners who completed the course. The average amount of activity for learners who completed was 84% and learners who did not complete was 16%.

A regression model of total activity by completers and non-completers for the same activities (56: MOOC/SPOC, 8: online) were also evaluated, as shown in Figure 17.

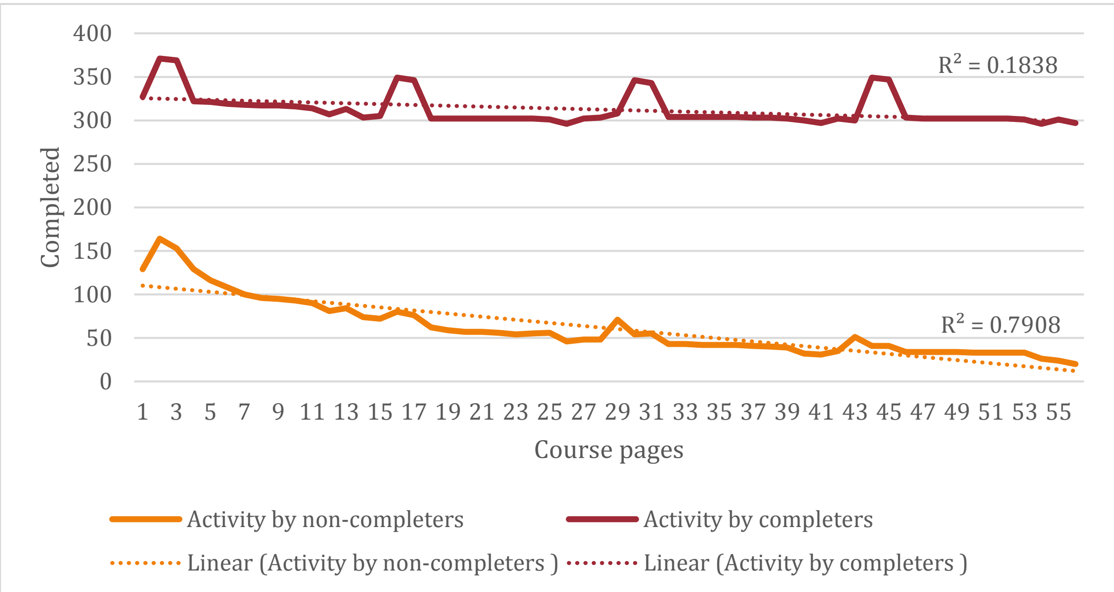


Figure 17. Total activity for completers and non-completers.

The estimated strength of the relationship between learner activity and students who completed (R^2=0.183) and did not complete (R^2=0.791) was determined. The percent of variance of learners who completed explained 18% and 79% for non-completers of the regression model respectively. However, the regression model emphasised that activity progression was not consistent over the course. Peaks were noted on initial learner commencement and then after the first three assessment quizzes but falling off as the learner reached the final assessment.

Direct logic regression was then performed to assess the impact of weekly activity progression on the likelihood that learners would complete. The model again contained 56 independent variables and, after the regression analysis, the full model containing all predictors (Appendix Z) was shown to be statistically significant [$\chi 2$ (46, n=509) =402.40, p<.001]. This indicated that the model could distinguish between learners who completed and those who did not complete. The model explained between 54.6% (Cox and Snell R square) and 75.2% (Nagelkerke R^2) of the variance in activity progression, and correctly classified 90.6% of cases. The results are shown in Table 39.

Table 39. *Direct logic regression results for significant activity progression*

Activity		**B**	**S.E.**	**Wald**	**df**	**p**	**Odds Ratio**	**95% C.I.for C.I. for Odds Ratio**	
								Lower	**Upper**
D1	Wk1ModAct	2.98	0.99	8.95	1	0.00	19.60	2.79	137.64
D2	W1T1Acti	-3.03	1.39	4.75	1	0.03	0.05	0.00	0.74
D13	Wk1DisFor	2.15	1.03	4.33	1	0.04	8.56	1.13	64.74
D29	Wk3ModAct	2.98	1.50	3.93	1	0.05	19.64	1.04	372.45
D46	W4T3Act	2.42	0.89	7.33	1	0.01	11.19	1.95	64.32

Five of the independent variables made a uniquely statistically significant contribution to the model. The strongest predictor of completions was 19.6. This indicated that learners are 19 times more likely to finish the whole course if they complete Week 1 Module 1, Week 3 Topic 1 and Week 4 Topic 3 than learners who do not complete that activity, controlling for all other factors in the model.

4.5.2.3 PCA, CFA, and SEM analysis

Structured Equation Modelling (SEM) was used to estimate causal relationships between the factors that impact on learner engagement and retention by using a combination of statistical and qualitative techniques. The SEM practices for this study were based on the recommendations from Jackson et al. (2009) and McDonald and Ho (2002) for conducting quality Confirmatory Factor Analysis (CFA). Twenty-nine demographic, participation and course rating factors that promote learner engagement and retention were identified from the Welcome to Canvas Survey for MOOCs and SPOCs and the CIT Enrolment Form for the online group. An exploratory factor analysis was conducted prior to performing the Principal Components Analysis (PCA) and then SEM for CFA was undertaken.

The initial factor analysis was used to explore the data patterns in engagement and retention in MOOCs, SPOCs, and online environments. The initial PCA was conducted on all learners for the following 29 indicators:

- **13 demographic variables (retention patterns)**
    - A1 Primary reason for taking course
    - A2 Type of learner
    - A3 Hrs per week of study
    - A4 Level of education
    - A5 English as the primary language
    - A6 Place living
    - A7 Gender
    - A8 Age
    - A10 Previous online course
    - A11 Previous online experience
    - A24 Pre-course learner goals
    - A25 Pre-course learner experience
    - A29 Learner’s completed course
- **14 participation variables (engagement patterns)**
    - A9 Hear about course

  - A12 Positive impact of course material
  - A13 Positive impact of course activities
  - A14 Course hours
  - A17 Instructor involvement
  - A18 Length canvas course
  - A19 Discipline interest
  - A20 Video interaction learning
  - A21 Video interaction use
  - A22 Video interaction enjoyment
  - A23 PDF vs Video interaction
  - A26 Post-course learner goals
  - A27 Post-course learner experience
  - A28 Participation in discussions
- **2 course rating variables (retention and engagement patterns)**
  - A16 Course overall rating scale
  - A15 Course recommendations

The PCA inspection extracted only 12 valid components, therefore these indicators were then subjected to another PCA. The components included:

- **6 demographic variables (retention patterns)**
  - A1 Primary reason for taking course
  - A2 Type of learner
  - A3 Hrs per week of study
  - A5 English as the primary language
  - A6 Place living
  - A10 Previous online course
- **4 participation variables (engagement patterns)**
  - A17 Instructor involvement
  - A20 Video interaction learning
  - A21 Video interaction use
  - A22 Video interaction enjoyment

- **2 course rating variables (retention and engagement patterns)**
    - A16 Course overall rating scale
    - A15 Course recommendations

Inspection of the correlation matrix for the 12 indicators revealed that all coefficients were 0.3 and above. The Kaiser-Meyer-Olkin value was 0.71 which is above the recommended value of 0.6 and Bartlett's Test of Sphericity reached statistical significance, indicating the correlation matrix was favourable (Pallant, 2016). The PCA revealed the presence of 3 components with eigenvalues exceeding 1. These explained 24%, 21% and 10% of each variance correspondingly. The component, pattern and structure matrix are shown in Table 40.

Table 40. *Component, pattern and structure matrix for PCA with two-factor solution of engagement and retention attributes for all learners*

Variable	Component coefficients		Pattern coefficients		Structure coefficients		Communalities
	1	2	1	2	1	2	
A22 Video interaction enjoyment	0.870		0.890		0.887		0.788
A20 Video interaction learning	0.818		0.832		0.831		0.690
A21 Video interaction use	0.755		0.773		0.770		0.595
A15 Course recommendations	0.576		0.575		0.577		0.334
A16 Course overall rating scale	0.484		0.481		0.484		0.235
A17 Instructor involvement	0.415		0.416		0.417		0.174
A3 Hrs per week of study		0.462		0.486		0.492	0.667
A2 Type of learner		0.747		0.739		0.726	0.557
A10 Previous online course		0.671		0.692		0.694	0.483
A6 Place living	-0.312	0.604		0.645		0.658	0.462
A1 Primary reason for MOOC		0.531		0.549		0.552	0.306
A5 English as the primary language		0.817		0.808		0.793	0.249

An inspection of the scree-plot (Figure 18) revealed a clear break after the second component and with guidance from the scree-test and Catell's recommendations (as cited in Pallant, 2016), two components were retained. The two components explained a total of 45% of the variance but there was a weak negative correlation between the two factors (r=-.07).

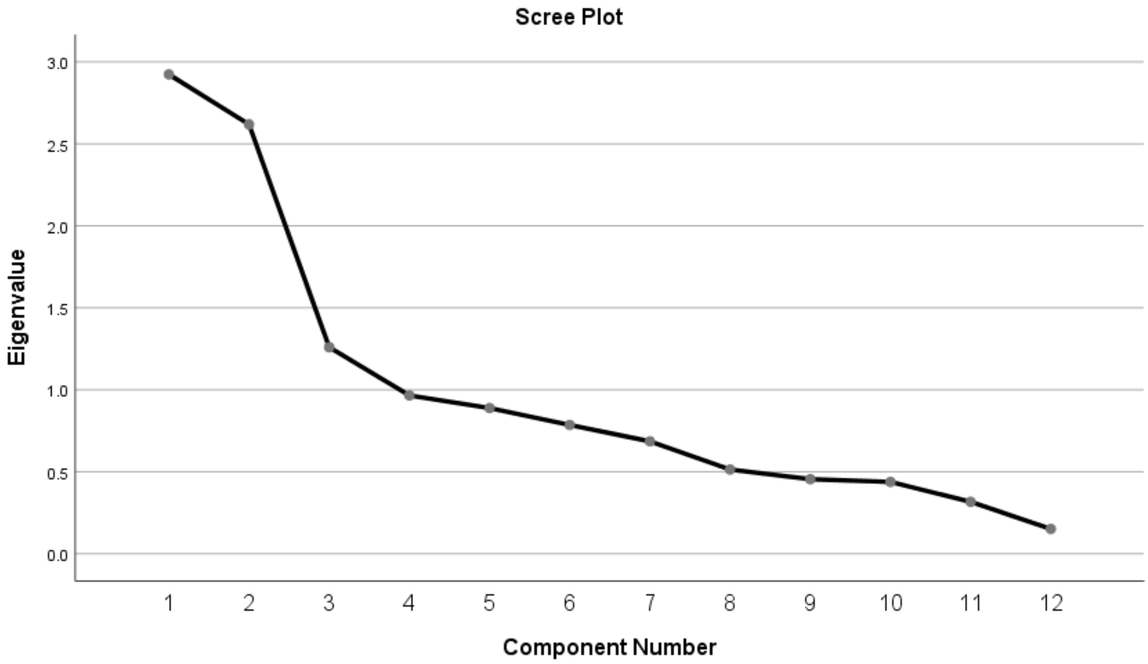


Figure 18. Scree-plot of engagement and retention attributes for all learners.

The variables from the PCA were covariance structure with multiple indicators for all latent constructs which made it suitable for SEM. The SEM followed Anderson and Gerbing's (1988) two-step approach. This approach uses CFA to develop an acceptable measurement model in the first instance. Then using the evidence supplied by the model, the underlying constructs are explored in order to develop a model that demonstrates an acceptable fit to the data. SEM allowed for hypotheses testing based on the prediction that the three factors: demographic, participation and course rating are predictive of learner achievement. The estimation procedure for the SEM was maximum likelihood which reduced the issues associated with multivariate normality (McDonald & Ho, 2002). The inclusion of an additional value of "no response" was applied to variables that contained no data. This resolved the issue of missing data and reduced the biases associated with missing data approaches such as deletion or substitution (Jackson et al., 2009). Anderson and Gerbing (1988) recommend that at least three indicators should be assessed for each latent factor but a two-indicator examination is suitable if both indicators show a high relationship to the model. This was the case for the learner's course rating factor assessed in the SEM.

The model realised by the factor 1 and 2 PCA data was unacceptable and had a poor fit to RMSEA [Model 1: $\chi 2$ (51, n=683) =364.36, p<.001, TLI=.95, CFI=.96]. The full standardised model is displayed in Figure 19. The standardised and unstandardised coefficients table for the CFM and the unstandardised path diagram are available in Appendix R: Model 1.

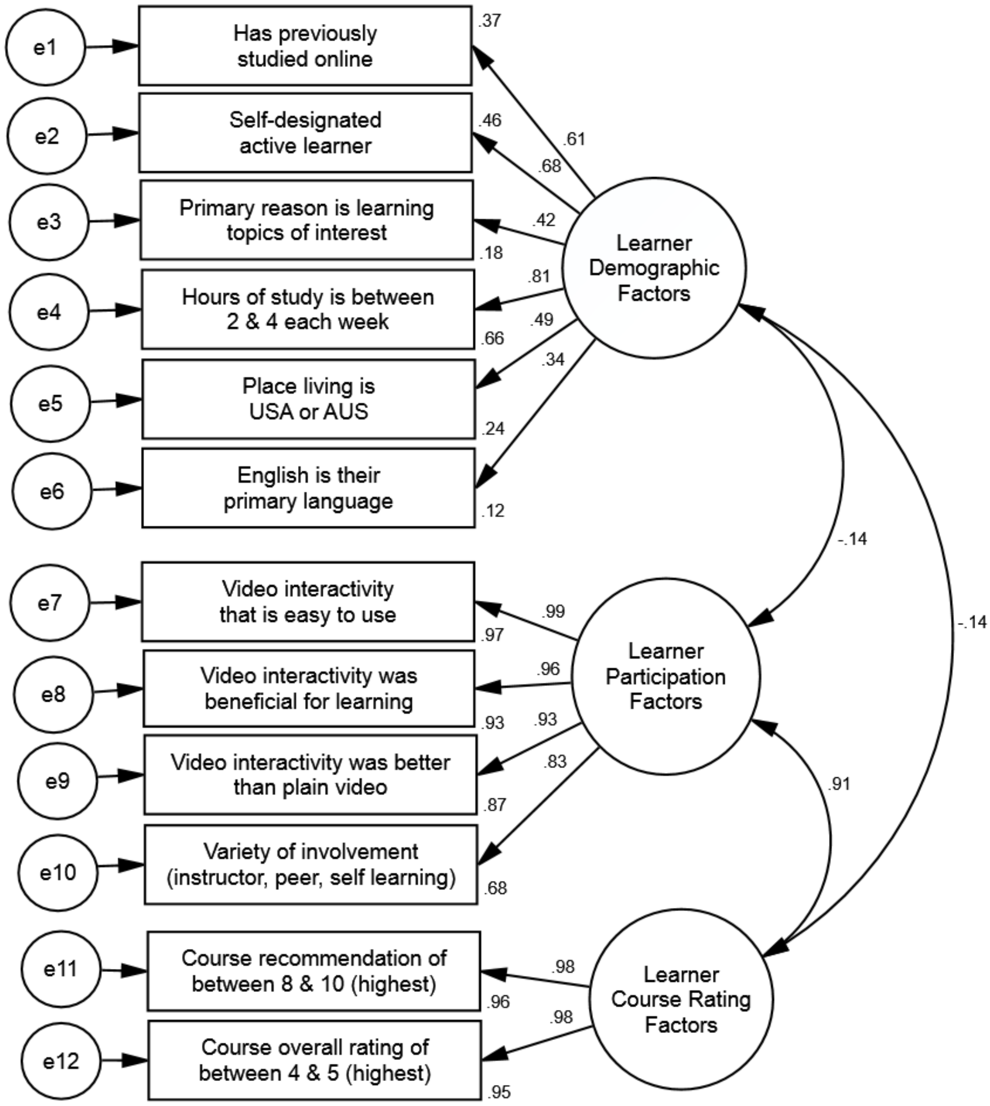


Figure 19. Model 1 path diagram of standardised coefficients.

As recommended by Anderson and Gerbing (1988), the first phase was to develop a measurement model that provides an acceptable data fit. The analysis of the standardised coefficients can determine the strength of each variable and low indicators can be removed to improve the model fit. As Model 1 was unacceptable, the model was then further refined by removing the variables with low r^2 values which were: A1 Primary reason for course (.42), A5 English primary language (.34) and A6 Place living (.49) as they had a low correlation to the study data and did not fit well within the model.

Model 2 also had a poor fit to RMSEA [Model 2: $\chi 2$ (24, n=683) =269.09, p<.001, TLI=.95, CFI=.97]. The standardised model is displayed in Figure 20. The standardised and unstandardised coefficients table and unstandardised path diagram for Model 2 are available in Appendix R: Model 2.

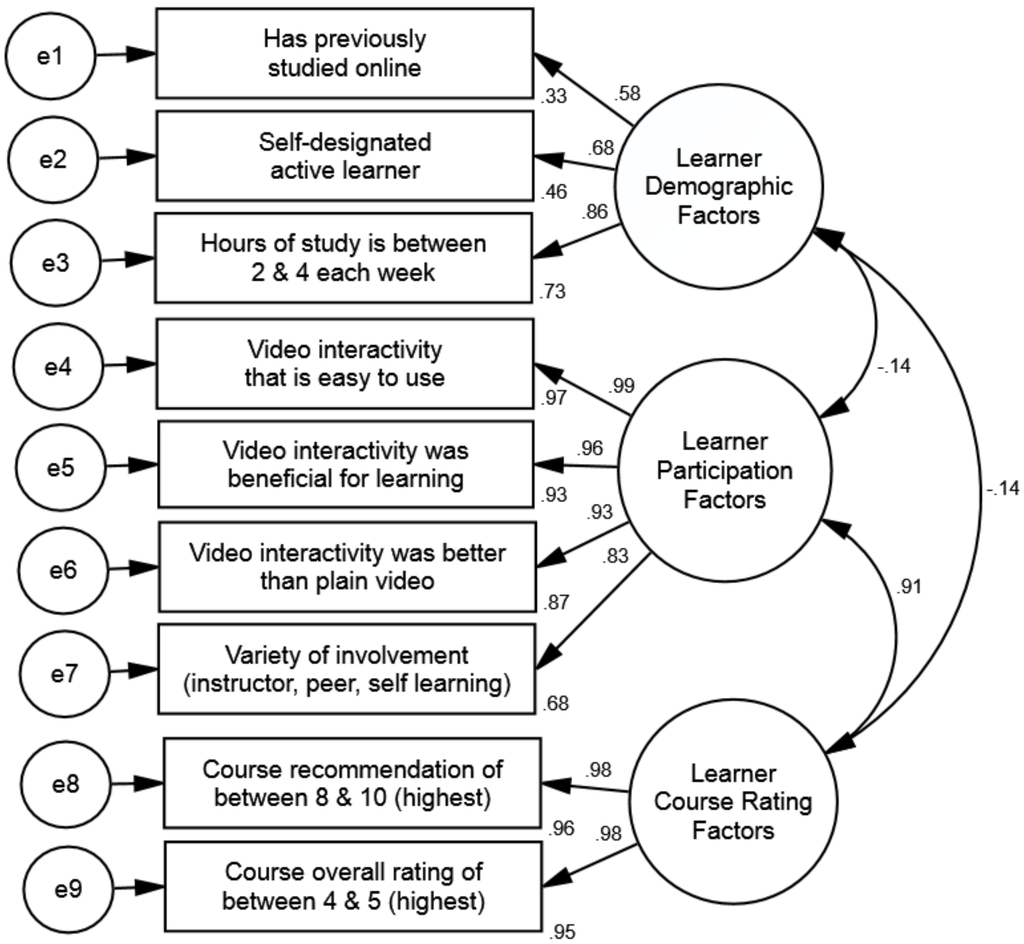


Figure 20. Model 2 path diagram of standardised coefficients.

To further enhance the model and to attain a suitable fit, the communalities were reviewed. As recommended (Pallant, 2016), any communalities that are <0.3 indicate they have a low correlation to the study data and should be excluded from the analysis. Variable A17 Instructor involvement had a communalities value of only 0.174 (Table 40) and was therefore removed from the model. The CFA was conducted again and remodelled on the following eight indicators:

- **3 demographic variables (retention patterns)**
  - A2 Type of learner
  - A3 Hrs per week of study
  - A10 Previous online course
- **3 participation variables (engagement patterns)**
  - A20 Video interaction learning
  - A21 Video interaction use
  - A22 Video interaction enjoyment
- **2 course rating variables (retention and engagement patterns)**
  - A16 Course overall rating scale
  - A15 Course recommendations

Model 3 was acceptable across all global fit indices [Model 3: $\chi 2$ (17, n=683) =47.72, p<.001, TLI=1.0, CFI=.99]. The Model 3 standardised path diagram is illustrated in Figure 21. The standardised and unstandardised coefficients table and path diagram for the unstandardised coefficients are available in Appendix R: Model 3.

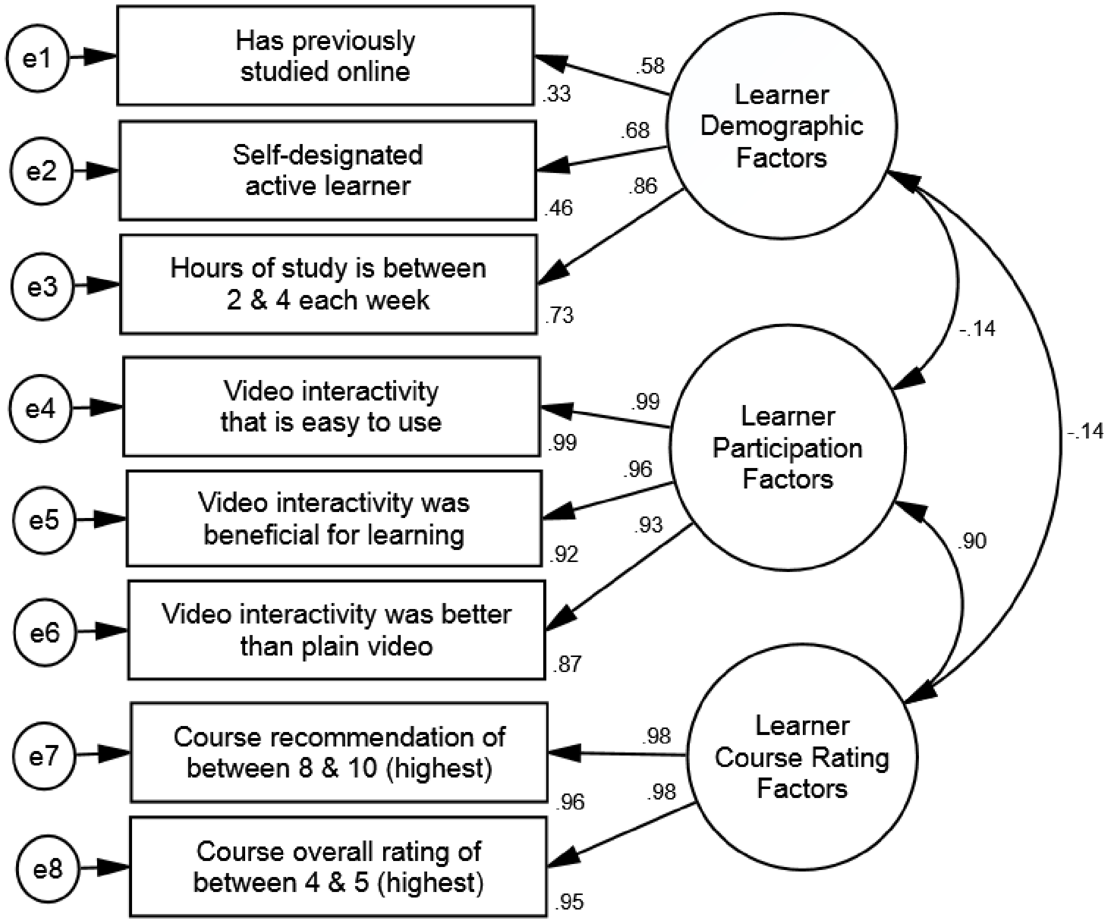


Figure 21. Model 3 path diagram of standardised coefficients with covariances.

The outcomes of acceptability for best fit were based on the recommendations of appropriate global fit indices as outlined by McDonald and Ho (2002), Jackson et al. (2009), Schreiber, Nora, Stage, Barlow, and King (2006), and Byrne (2016). The global fit indices for all models are presented in Table 41.

.

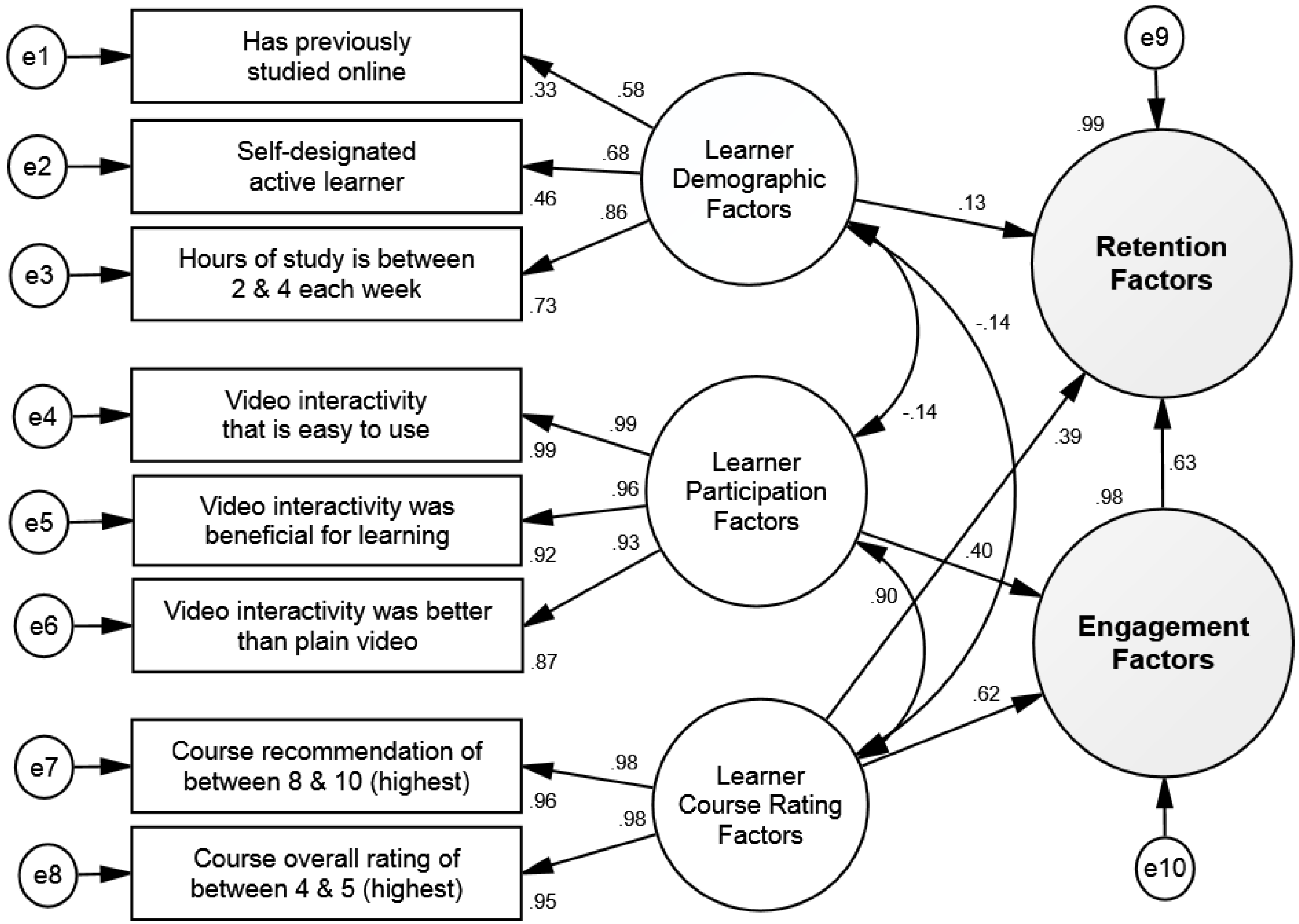
Table 41. *Global fit indices of engagement and retention factors for Models 1–3)*

Model	TLI	CFI	NFI	IFI	RMSEA	PCLOSE	SRMR
1	0.946	0.958	0.952	0.958	0.095	0.000	0.049
2	0.949	0.966	0.963	0.966	0.122	0.000	0.041
3	0.992	0.995	0.992	0.995	0.051	0.415	0.033

Key: TLI=Tucker Lewis index; CFI=Comparative fit index; NFI=Normed fit index; IFI=Incremental fit index; RMSEA=Root mean square error of approximation; PCLOSE= Confirmatory factor analysis fit indices; SRMR=Standardised root mean square residual.

4.5.2.4 Final measurement model

Based on the acceptability of Model 3 [$\chi2$ (17, n=683) =47.72, $p<.001$, TLI=.99, CFI=1.0], it was further expanded and linked to the respective engagement and retention factors. The standardised path diagram, parameters from the measurement model and the structural relationship between the path coefficients for Model 4 are shown in Figure 22. The global fit indices identified were within acceptable parameters $\chi2$(17, n=683) =47.72, $p<.001$, TLI=.99, CFI=1.0, NFI=.99, IFI=1.0, RMSEA=.05, PCLOSE=.42, SRMR=.03. The Model 4 standardised and unstandardised coefficients table and path diagram for the unstandardised coefficients are available in Appendix R: Model 4. The range of standardised factor loading for the final model was .58 to .99 with only one indicator variable less than .60 and none of the values were trivial (Anderson & Gerbing, 1988). All factor loadings were statistically significant ($p<.01$) and there was support for the convergent validity of responses against the eight-indicator model. Therefore Model 4 was accepted as the final measurement model for this study.



Engagement and retention is the learners' judgement of success through improved knowledge and skills, and their ongoing recommendations to others.

Figure 22. Model 4: Final measurement model path diagram of standardised coefficients with covariances.

The SEM hypothesised engagement (51%) was 13% more predictive of course achievement than retention (38%). The final model revealed the strength of the relationships between the study variables and the factors most conducive to learner engagement and retention. These are illustrated in Figure 23.

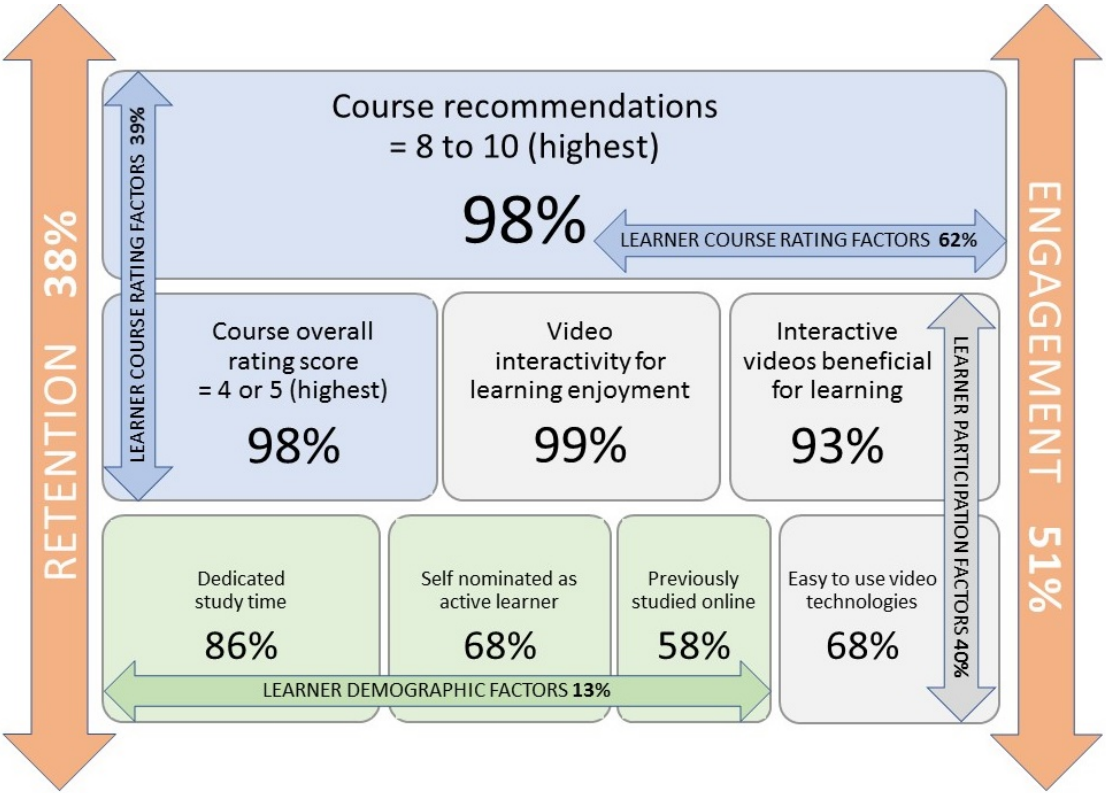


Figure 23. Final model engagement and retention relationships.

There was a hypothesised direct effect of engagement (62%) on retention (39%) and both were indirectly affected by the learner course rating factors. The influence of the learner course rating factors was noted when 4–5 out of 5 for the course overall star rating score (98%) and 8–10 out of 10 for the course recommendations (98%) were nominated. This suggests that if learners perceive the course as enjoyable and if it has an educational undertone which includes self-marked assessments and learning pathways, learner engagement is stronger. The study by de Freitas et al. (2015) confirmed this in their review of the star rating results for 369 MOOC learners. They found improved completion rates when learners' comments were positive and a course rating score of 90% was given. However, course completion based on student enjoyment was not seen as conditional and the course also needed to fit within the time constraints of the learner and the learning process needed to be perceived by the learner as achievable for improved retention (Gorky, 2014).

The learner participation factors had a direct effect on engagement (40%) but also had an indirect effect on retention (25%). The learner participation factors were comprised of video interaction learning (93%), video interaction use (68%), and video interaction enjoyment (99%) and were influenced by quality learning activities that were easy to use (68%). These were seen to enhance learning and reinforce the retention of information. Wang and Baker's (2015) study found a similar finding where the student's interest in the content was more important to the learner than completing the course. Therefore, higher levels of engagement can be achieved when a variety of learning resources (Downes, 2010) and interactive learning tasks (Gamage et al., 2014) are used in the learning process.

Learner demographic factors (13%) had a smaller but direct effect on retention. These included 2–4 hours of study each week (86%), self-designated active learners (68%), and learners who had previously studied online (58%). These characteristics were seen as an advantage for retaining learners. Engle et al.'s (2015) study evaluated the same three traits from 33,387 MOOC learner pre-course survey responses and found that dedicated study time, an active learner type, and previous online experience were significant for engagement. Their analysis of student intention showed that from the 44.8% of learners who answered that they would complete all the course activities, in practice, only 6% completed them totally but activity was still high among active learners. In their research, the hours spent studying was also found to be consistent with the course recommendations of 6–8 hours per week and improved completions, although the outcome suggested that many students were not able to accurately predict how much of the course they would complete. The learner’s previous experience was also found to be significant in Engle et al.'s (2015) research, with 5% more learners passing the course if they had previously studied online and had a prior knowledge of the topic. In comparison with the findings of this study, VET learners who dedicated time and actively participated in the learning tasks had stronger engagement and were 60% more likely to complete the course.

In reviewing the SEM path model through the standardised direct and indirect effects, the patterns of causal structure linked several variables relative to retention and engagement. A bootstrap approximation was obtained by constructing two-sided bias-corrected confidence intervals. The bootstrap technique was advantageous as it provided a mode by which to assess the stability of parameter estimates, greater accuracy of predicted estimates and a mechanism to address multivariate normality (Byrne, 2016). The bootstrap samples for n=2000 (Appendix R, Model 4) were estimated on the two-sided bias-corrected percentile method (BC) to obtain confidence intervals and significance tests at 95%. The BC direct, indirect and total effects are presented in Table 42.

Table 42. *Bootstrap results from Structural Equation Modelling*

	β			B				
Model	**CF**	**PF**	**DF**	**CF**	**PF**	**DF**	**SE**	**r^2**
Direct								
Engagement	.62**	.40**		1	1		.001	.979
Retention	.39**		.13**	1		1	.000	.992
A16 Course overall rating	.98**			.51			.017	.951
A15 Course recommendation	.98**			1			.014	.964
A20 Video interaction learning		.93**			.89		.016	.871
A21 Video interaction use		.68**			1		.012	.918
A22 Video interaction enjoyment		.99**			1		.011	.986
A3 Hrs per week of study			.86**			.98	.053	.731
A2 Type of learner			.68**			.45	.040	.459
A10 Previous online course			.58**			1		
Indirect								
Retention	.39**	.25**		1	1			
Total								
Engagement	.62**	.40**		1	1			
Retention	.77**	.25**	.13**	2	1	1		
A16 Course overall rating	.98**			2	1	1		
A15 Course recommendations	.98**				.89			
A20 Video interaction learning		.93**		1	1			
A21 Video interaction use		.96**		.51				
A22 Video interaction enjoyment		.99**		1				
A3 Hrs per week of study			.86**		1			
A2 Type of learner			.68**		1			
A10 Previous online course			.58**			1		

Key: CF (Learner Course Rating Factors), PF (Learner Participation Factors), DF (Learner Demographic Factors).
** Correlation is significant at the 0.01 level.

There was a hypothesised positive direct unmediated and indirect mediated effect of course rating factors (CF) on engagement (.62) and retention (.39). Although engagement was 23% more predictive of course achievement than retention, both variables were still statistically significant at p=.001. There was a positive direct unmediated and indirect mediated effect of learner participation factors (PF) on retention (.25) and learner demographic factors (DF) had a positive direct unmediated effect on retention (.13). Once again, all variable effects were statistically significant.

The correlation between the observed variables was also statistically significant and had a direct unmediated effect on engagement and retention. Both course recommendations (.98, p=.001) and course overall rating scale (.98, p=.002) were the strongest engagement and retention predictors with 98% for course rating factors. While video interaction enjoyment (.99, p=.001) was the highest predictor of learner participatory factors, the ease of video interaction usage (.96, p=.002) and video interaction for learning (.93, p=.002) improved the learners' experience and promoted stronger engagement. The learner demographic factors for the number of hours a student spends on studies each week was the highest predictor of learner retention (.86, p=.001) but an active learning type (.69, p=.001) and previous online study experience (.58, p=.001) were also positively related to learner retention.

The final model indicated that retention patterns were reliant on learner type, dedicated study time and previous online experience, combined with a high course rating and course recommendations. Engagement patterns were based on the learner having a positive experience with the interactive video tools and the benefits of these technologies for use, enjoyment and learning. The direct effects established by the observed variables in the final model supported the definition of retention as the learner's self-judgement and positive recommendations on the course benefits to others. This is reinforced by Gorky's (2014, p.18) description where "learners' judgement of success" and the importance of "ongoing recommendations to others" are his measures of retention. However, Gorky's definition does not provide a sufficiently reliable measure of student judgement. Therefore, this study proposes an that: *Engagement and retention is the learners' judgement of success through improved knowledge and skills, and their ongoing recommendations to others*. Additionally, the structural relationships between the latent variables; learner demographic factors, learner participation factors and learner course rating factors, when interpreted on the multiple squared correlation for the retention (.13) path coefficient, accounted for 13%. A variance of 1% for e9 retention factors and 2% for e10 engagement factors reduced the path coefficient lower-bound reliability by 3%. Therefore, the model accounted for an additional 10% of learners being retained and engaged in the course.

4.5.3 Impact of delivery preferences on engagement and retention

The course time allocation and the release of content were important considerations when developing a MOOC as these factors can change the learners' perception of their potential to complete. A frequency analysis was conducted on the hours a student planned to study (A3 Hours per week) from their selection on the pre-course Welcome to Canvas survey and by evaluating students' responses on the post-course Canvas User experience survey for the amount of time spent on studies (A14 Course hours student spends). Another measure was taken from the student selections for the recommended length a Canvas course should run for (A18 Length of canvas course) as a further comparison. The date the learner commenced and the date the learner completed the last assessment activity for MOOC 11 and SPOC 6 were also evaluated. An improvement in learners' completions was the outcome when MOOCs changed enrolment type (from a specified start date amended to enrol any time) and after the removal of the four-week completion timeframe.

4.5.3.1 Comparative analysis of frequencies for learners' hours planned for study and hours spent on studies

All learners have life, work, and family commitments. This means that study often takes second or third place to the demands of everyday life. The amount of time attached to a course can be a reason why the student does not enrol in the first instance, but an alternative outcome, particularly for MOOCs, is that the student does commence but drops out once the workload is realised. The variable values for A3 Hours per week ranged from less than 1 hour, up to more than 8 hours per week and for A14 Course hours student spends, the same values were compared. The frequency of 2–4 hours per week was the amount of time that 35%–48% of students spent each week on their studies. This was consistent with the recommended course hours. In comparison with the hours the student actually spent, a similar outcome was seen with 31%– 40% taking 2–4 hours to complete the weekly learning tasks and assessments, as displayed in Table 43.

Table 43. *Frequency values for the A3 Hours per week planned for study and A14 Course hours spent on studies*

Group	Value	n	Frequency	%
All	A3 Hours per week: Between 2 & 4 hours per week	683	241	35.3
MOOC		543	220	40.5
Completed MOOC		288	108	37.5
SPOC		47	21	44.7
All	A14 Course hours student spends: Between 2 & 4 hours per week	302	116	38.4
MOOC		288	103	39.3
Completed MOOC		219	87	39.7
SPOC		35	11	31.4

It was interesting to further explore these time allocations, and the next highest frequency values for all learners was split relatively evenly between 1–2 hours and 4–6 hours each week. This comprised 18% for all learners (n=543) (Appendix P), 22% and 21% for MOOC (n=543) (Appendix AA), and 20% and 23% for the completed MOOC group (n=288) (Appendix AB). For SPOC students the range was 13% and 19% (n=47) (Appendix AD). Therefore, on average 20% of MOOC and SPOC learners took 1–2 hours longer than the 4–6 hours recommended each week and the same number of learners also reduced their study time by 1–2 hours. However, for the number of hours a student spent each week on their studies there was more discrepancy between learner selections, with 7% and 11% for all learners and the MOOC group, 26% and 9% for the completed MOOC group, and 13% and 19% for the SPOC group.

4.5.3.2 Spearman's Rho correlations for learners' hours planned for study, hours spent on studies and length of course

To further explore the correlations between A3 Hours per week, A14 Course hours student spends, and A18 Length of Canvas course, a Spearman's Rho test was performed on all learners. The values for A18 were between 0–2 weeks and up to 8 weeks or more (Appendix P). The relationship between the learner's planned hours and the hours a student spends on studies resulted in a strong positive correlation between the two variables, r=0.57, $p<.001$ (A3: n=683, A14: n=302). Therefore, the hours a student perceives to spend on their studies and the hours actually spent was comparable. The correlation between total hours spent each week (A14) and the most suitable length for a MOOC to run on the Canvas network (A18) was also statistically significant (r=0.15, $p<.001$, A14: n=302, A18: n=300) but only a low positive correlation was noted. There was no statistical significance detected in the relationship between A3 and A18. This would suggest that learners who allocate a certain amount of dedicated time to their studies and are able to stick to their schedule, as long as the schedule fits within the course recommendations, those learners are more likely complete.

4.5.3.3 Descriptive analysis of learner completions for flexible and structured course timeframes

A final analysis was conducted on MOOC 11 and SPOC 6 learners, to determine if the flexible completion timeframe was an indicator that more students would complete the course. The initial study examined learners over four weeks (28 days) from the course commencement date. While MOOC 11 and SPOC 6 learners could enrol and complete at any time (Jan 18–Jun 18), for the completed group of learners (n=37) the range of days to complete was between 1 day (16%) and 55 days (3%) with the average being 15 days to complete the MOOC, as illustrated in Figure 24. Consequently, 14% more learners finished the MOOC/SPOC, when the courses completion time was extended.

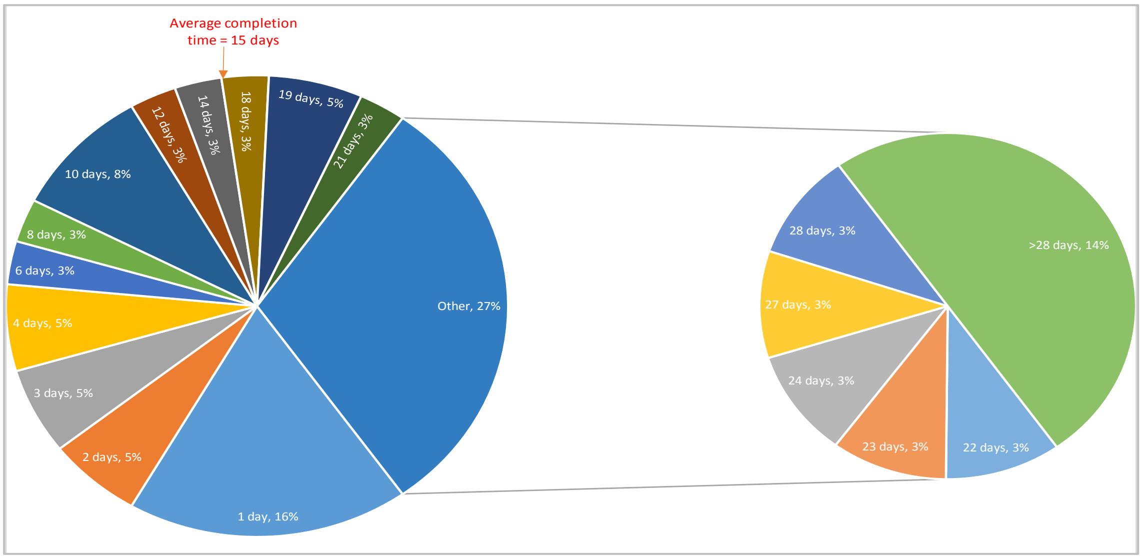


Figure 24. Total number of days for learners to complete MOOC 11.

4.5.4 Summary of Research Question 2

The factors analysed for learner engagement and retention for technology-rich online courses was instructor's commitment to the learning process, learner participation patterns and learner content release preferences with consideration of time-zone variances.

Instructor presence was important for 10% of learners but students still wanted a "real" person to be accessible and to oversee the course. Over 32% of all learners and 43% of completed learners preferred a variety of involvement strategies and these included self, peer and instructor-based interactions. Learners also favoured optional discussion as did the less social learners, and completions improved by 3% when optional was the requirement. The Mann-Whitney U testing for H_{12} Learner's preference for instructor involvement revealed statistical significance (p<.05) for the SPOC group with a very large effect designation. The learners' perceptions of the instructor found 108 occurrences of the word *teacher* or *instructor* with many comments of appreciation bestowed directly to the course facilitator on the effectiveness of the course design.

The analysis of learner classifications found 71% of learners knew their learner classification type before commencing the course. Active participants had a steady flow of activity for 60% of the course and this reduced to 40% for passive learners, 20% for observers and 10% for drop-in learners. The direct logic regression of learner progression over 56 course pages for MOOC/SPOC and 8 course pages for online learners indicated that for completed learners the average activity completion rate was 84% and for non-completers it was 16%. These findings indicated learners are 19 times more likely to complete the course after they commence Week 1 Module 1, Week 3 Topic 1 and Week 4 Topic 3. The regression analysis confirmed these three factors to be statistically significant at $p<.05$.

Twenty-nine demographic, participation and course rating factors that promote learner engagement and retention were examined through exploratory factor analysis prior to performing the PCA (Principal Components Analysis) and then SEM (Structured Equation Modelling) for CFA (Confirmatory Factor Analysis). The final measurement model was comprised of eight variables, three for demographic (retention patterns), three for participation (engagement patterns) and two for course rating factors (retention and engagement patterns). The SEM hypothesised engagement (51%) was 13% more predicative of course achievement than retention (38%). There was a direct effect of engagement (62%) on retention (39%) and both were indirectly affected by the learner course rating factors. The influence of the learner course rating factors was gained from the course overall star rating scores (98%) and course recommendation (98%). The direct effect of learner participation factors was 40% on engagement and indirectly a 25% effect on retention. The variables that influenced the learner participation factors was 93% video interaction learning, 68% video interaction use and 99% video interaction enjoyment. Retention had a 13% direct but small effect from learner demographic factors which included 86% for 2–4 hours of study each week, 68% for self-designated active learners and 58% for learners who had previously studied online.

Over 80% of learners spent 2–4 hours each week on their studies and this was found to be comparable to the course timeframe recommendations. The Spearman's Rho correlations for the study hours a student perceives to spend on a course and what they indeed spent, had a low positive correlation but was statistically significant at $p<.01$. The average time to complete the four-week MOOC was 15 days; however, 14% of students took longer than 28 days and some took up to 55 days (3%) to complete. The results also suggested that learners that allocate dedicated time to their studies are more likely to complete given other personal constraints are manageable. Also, if students are given additional time to complete the course, 14% more learners are likely to finish.

4.6 Research Question 3: What are the relationships between student retention in VET MOOCs, SPOCs, and online environments?

The quality of the course design can influence student retention and in a study of 369 MOOC students, a steady withdrawal rate of 5% over the progression of the course was documented (de Freitas et al., 2015). As such, the instructional development for a technology-rich online course needs to acknowledge the learners' geographical distance and the lack of face-to-face support that occurs in these courses. Specifically, for a MOOC, the initial topology that establishes the course should include collaborative mechanisms for discussion, instructor accessibility options, achievable course requirements, quality assessment tasks that are linked to the UoC, and practical learning materials and activities.

4.6.1 Quality instructional course design blending delivery topologies

The CIT MOOC's underlying theory is a cMOOC or connectivism topology. The focus for connectivism is similar to online delivery practices where delivery of electronic materials incorporates andragogy and peer networking strategies. However, the emphasis for a cMOOC is the overall collaborative nature

(Gamage et al., 2014), therefore blending techniques that develop ongoing connections in the courses' design are important strategies to consider (Bell, 2010; Downes, 2010; Siemens, 2005). Many of the influential components that affect course quality have been previously discussed in this chapter, as indicated below:

1. Peer discussion for collaborative communication (section 4.4.1).
2. Certification (formal or informal) and pathways to further learning (section 4.4.2).
3. Instructor visibility and accessibility (section 4.5.1).
4. Manageable course timeframes (section 4.5.3).
5. Dependable assessment instruments (section 4.7.1).
6. Effective course materials (presented in this section).

The structure and configuration of the course design can influence learner retention (Paton, Scanlan, et al., 2018). An examination of the learners' perceptions of course materials, resources and the overall course was undertaken to understand these influences. The course design has been previously discussed for the MOOC in Section 3.3.3.1 and online delivery in Section 3.3.4.

4.6.1.1 Comparative survey analysis for MOOC/SPOC and online learners

An examination for comparability between the CIT Subject Evaluation and the Canvas User Experience Survey was conducted. This was a somewhat difficult process as the questions across both were considerably different. However, there were similarities among three questions, as shown in Table 44.

Table 44. *Question alignment between post-course CIT Subject Evaluation and the Canvas User Experience Survey*

CIT Subject Evaluation		**Canvas User Experience Survey**	
E1	What overall rating would you give the subject?	A16	Please give this course an overall rating?
E5	The resources for this subject were sufficient?	A12	The course materials (lectures, videos, documents) have a positive impact on my learning experience?
E6	The resources were easy to understand?	A13	The course activities (discussions, assignment, project, quizzes) have a positive impact on my learning experience?

For the purposes of seeing if the content delivery style had any association with the learners' responses, exploration of the frequency distributions for the comparative questions was conducted (Appendix AG). The outcomes were consistent for the MOOC/SPOC and online groups for the course star rating scale, with learners bestowing the highest score for these variables (A16 MOOC/SPOC: n=144, 46.5%, E1 online: n=14, 58.3%). But there was a difference in responses for the sufficiency of resources where the highest ranking for MOOC/SPOC was Strongly Agree (A12: n=143, 46.4%) and for the online group it was Agree (E5: n=15, 62.5%), with only 38% in strong agreement. With the comparison of whether the resources were easy to understand, Agree was the most commonly selected response from both groups (A13: MOOC/SPOC: n=159, 52.5%, E6: online: n=15, 62.5%).

To gain a better understanding of online learners' perceptions of the course materials and activities, E5:A12, E6:A13, and E1:A16 were evaluated. From the frequency distributions for E5 and E6 it was revealed that 100% of online learners Agree or Strongly Agree the resources were sufficient (A12: MOOC/SPOC: n=143, 46.4%, E5: online: n=15, 62.5%) and easy to use (A13: MOOC/SPOC: n=159, 52.5%, E6: online: n=15, 62.5%). This was comparable to MOOC/SPOC learners for A12 and A13 where approximately 90% of learners felt the course materials and activities had a positive impact on their learning. The overall course rating for the online group was 89% for Excellent or Very Good and this was similar to the MOOC/SPOC group where 89% gave the highest or second highest rating (A16: MOOC/SPOC: n=144, 48.0%, E1: online: n=14, 58.3%). This is a very high percentage and indicates that learning materials, activities and the overall course design has a major impact on learner completions.

4.6.1.2 Retrospective causal-comparative design for learners' post-course perceptions of course materials and activities (H_9 & H_{10})

Mann-Whitney U tests were performed on the learner groups for H_9: The course materials were relevant and had a positive impact on the learner and H_{10}: The course activities had a positive impact on the learner against the MOOC 1 control group. Online learners were not included in this part of the analysis. The outcome for relevant and positive course materials (H_9) was not statistically significant for any learner group but the course activities' having a positive impact on the learner (H_{10}) was statistically significant, as shown in Table 45.

Table 45. *Mann-Whitney U test results for H_{10}: The course activities had a positive impact on the learner*

Group	Md	n	U	z	p	r	Effect
MOOC 1 control group	1	67					
MOOC/SPOC	2	298	6721.5	-1.83	0.068	0.11	
MOOC	2	263	5867.5	-1.44	0.150	0.09	
SPOC	1	102	854.0	-2.56	0.010	0.25	Small

Note: Variable significance levels $p<.05$ are highlighted in green.

The small effect noted for the SPOC group was consistent with their perceived dissatisfaction of moving between Canvas and CIT eLearn platforms.

4.6.1.3 Frequency analysis of MOOC/SPOC learners' perceptions of course materials

The relationship between the learner and course materials were analysed for all learners, completed MOOC and completed SPOC/online for A20 Video interaction for learning, A21 Video interaction usage, A22 Video interaction for enjoyment and A23 PDF vs video interaction, to develop a better understanding of the delivery tools used most frequently by learners. The highest frequency values for all variables are presented in Table 46.

Table 46. *Highest frequency values for content preference (A20, A21, A22 & A23)*

Variable		Delivery model	Value	*n*	%
A20	Video interaction for learning	All	7 Interactive video content deepened my understanding of course topics	70	24.3
		Completed MOOC	7 Interactive video content deepened my understanding of course topics	59	27.7
		Completed SPOC/online	1 Interactive video content made no difference in my learning	8	25.0
A21	Video interaction usage	All	7 Easy to use	113	39.1
		Completed MOOC	7 Easy to use	87	40.7
		Completed SPOC/online	7 Easy to use	11	34.4
A22	Video interaction for enjoyment	All	7 I would enjoy using Video Interaction again	91	31.6
		Completed MOOC	7 I would enjoy using Video Interaction again	73	34.3
		Completed SPOC/online	Rating 4 and 5 with the lowest being 1 I would not enjoy using Video Interaction again and 7 is above	8	25.0
A23	PDF vs video interaction	All	7 I used both Interactive PDFs and Video Interaction	70	22.2
		Completed MOOC	7 I used both Interactive PDFs and Video Interaction	39	35.5
		Completed SPOC/online	7 I used both Interactive PDFs and Video Interaction	15	53.6

The consensus was that the video content deepened the experiences of all and completed MOOC learners. The technologies were easy to use, and the interactive activities provided learning and enjoyment. The PDFs were also a good alternative for students and were used as either a learning or reinforcement tool.

4.6.1.4 Qualitative analysis of MOOC/SPOC learners' perceptions of course content, activities, and materials

An appraisal of the common word phrases from the Text Analyser (section 4.3.2) and word cloud frequencies (section 4.3.3) were evaluated for MOOC and SPOC learners (n=349) from the pre- and post-Canvas surveys (A24-A27). The sixth, seventh, and eighth top phrases were: *My level of understanding of biometric has greatly* (5), *presenting this course in a very positive* (2) and *information builds upon for future learning* (2). The word cloud also provided insight into the learners' thoughts on the course materials with the top eight frequencies being: *knowledge* (284), *learning* (257), *work/job* (216), *like* (143), *good* (91), *great* (82), *enjoy* (59), and *excellent* (18). This is indicative that the MOOC is a good learning tool for building knowledge and skills for a new career or ongoing professional development, but the key was the variety of learning tools which provided a mix of academia and fun.

The perceptions of online learners were that the course gave them the flexibility to complete at any time and when it suited their individual needs. The comment below is reflective of this point:

> *"I enjoy the content I am learning, I feel more comfortable doing the course work in my own home rather than a school environment and much highly prefer to be away from the school environment. A personal goal for me is to enhance my own freedom of choice and enjoy the learning experience in a space where I am comfortable."*

Learners also acknowledged that the innovative course delivery with interactive videos and PDFs made the learning more engaging and this was supported by these insightful comments:

> *"I am an adult learner with no formal qualifications except a Cert IV currently undertaking at CIT face to face delivery. I have always had a keen interest in learning and development and believe the old models of online study delivery are not dynamic and lacked interactions that were*

> *meaningful for the participant. This course's approach to learning caught my attention."*
>
> *"The format is easy to navigate, and well designed. The content is comprehensive, and I enjoy the freedom to move at my own pace."*
>
> *"The variable approaches one can take to this course make the experience a very dynamic [sic] and easy to tailor to personal strengths and learning styles as well as fitting in with personal and professional commitments."*

However, some learners did have issues with the interactive videos, as described by this student:

> *In general, I have used both pdfs and videos but have found that some of the answers to the questions vary between them. Also, using a work computer with tight restrictions on web browsers, the videos sometimes are clunky and make it difficult to use to its potential.*

4.6.1.5 Qualitative analysis of online learners' perceptions of course content and materials

A qualitative analysis of online learners' responses from the open response questions in the CIT Subject Evaluation (Appendix G) was conducted to understand the learners' perceptions of the course content and materials. An evaluation of online learner top phrases (section 4.3.4) from eight and seven words was: *To stay up to date with the readings (7)* and *knowledge and skills learned during MOOC (2).* The word cloud frequencies (section 4.3.5) for online learners (n=25) were: *video* (4), *readings* (4) and *content* (2). These imply that the learning materials and activities played a major role in the learning process. Minimal comments were given by students but some of the best aspects for online learners (n=17) were:

> *"The MOOC course was a great intro, and it was good to be able to follow it up with an assignment to reinforce the learning."*

> *"The lead up reading and structured approach encouraged learning and also assisted to identify gaps in my understanding initially. This provided a shaping effect and allowed me to tailor my own learning to the subject. The flexibility provided in the final project report, also enabled me to pick a subject to explore in depth."*

> *"The flexibility of online learning. I have a young child and don't think I would have been able to complete this if delivered face to face."*

The aspects that could be improved from an online learner's (n=8) perspective was also detailed by these comments:

> *"It was difficult to look up information in the course - perhaps a PDF of the whole course would be helpful to research for this subject."*

> *"The project asked for a report (I completed it as per CIT requirements) but teacher wanted an essay...... Requirements need to be clearer."*

4.6.2 Summary of Research Question 3

The factors that promoted student retention in online delivery models were sound instructional designs that utilised andragogical concepts blended with a connectivism topology. Building a MOOC with these attributes strengthens the relationship between learner and course materials, making it easier for the learner to succeed.

The effectiveness of the learning materials and activities were examined post-course for MOOC/SPOC learners and compared to online learners. There was commonality found among the groups with learners in agreement (MOOC/SPOC: 48%; online: 58%) that the resources were sufficient and easy to understand (MOOC/SPOC: 46%; online: 63%). However, the quality of resources was ranked differently between the groups with 46% of MOOC/SPOC learners in strong agreement that the resources made a positive impact on their learning whereas only 38% of online learners ranked Strongly

Agree. Similar results were seen in the frequency examination and comparisons of the comparable variables. There was strong agreement that the video content deepened the learners' experience (24%) especially for completed MOOC learners (27%) with usage and enjoyment other key attributes that retained learners for longer. Learning tools also positively impacted learners with 22% of all learners using both the interactive video and interactive PDFs to achieve. The Mann-Whitney U test for H_{10}: The course activities had a positive impact on the learner was statistically significant (p<.05) for the SPOC group with a small effect. These findings are representative that innovative course design can positively impact learner retention, although dissatisfaction was noted from SPOC learners as the movement between two learning platforms was perceived as confusing and reflective of the small effect.

The qualitative analysis of MOOC and SPOC learners' perceptions of course content, activities and materials were examined. Learners were positive that the learning aided in the building of information and skills for a possible future career. The interactivity was seen to provide a fun learning environment and the interactive video and PDFs reinforced knowledge while also accommodating the individual's learning style. The flexibility of the course was reflected by many students as a positive attribute and for some individuals, they would not have been able to complete if the course had more stringent requirements or longer timeframes. The online learners did not have the innovative learning tools that MOOC/SPOC students did for their studies and although they did give positive responses for course flexibility they also requested alternative learning tools to be incorporated into the design of CIT's online courses.

4.7 Research Question 4: What are the relationships between student engagement in VET MOOCs, SPOCs, and online environments?

Engagement is the process of learner progression and their ongoing capacity to achieve the course assessment requirements. There is evidence that learners without the underpinning skills may take longer to achieve or drop-out (Hew, 2014). Therefore, well-designed assessment instruments that are manageable and reflective of the learning materials will engage students for longer, as will the practice of offering formal learner pathways.

4.7.1 Well-developed assessment tasks interlaced with course outcomes

Well-developed assessment tasks are flexible, valid, reliable, sufficient, follow the rules of evidence and the principles of assessment, and provide a consistent measure of learners' success. In the MOOC, four compulsory self-marking quizzes were used to formatively assess the students' knowledge and practical skills. A peer-assessment model was not instigated as most literature urges MOOC developers away from using peer-review as it has a negative effect on learner completions (Jordan, 2015). Also, the coordination and time taken to organise peer marking with a global audience can be complicated.

4.7.1.1 Comparative analysis of assessment variables

An analysis of the descriptive statistics for the four compulsory assessment tasks (B1–B4), final assessment score (B5) and the percentage of the course completed (B6) was undertaken to determine the aspects that promoted or reduced learner engagement. The descriptive results for the various groups are available from: All learners: Appendix P; MOOC learners: Appendix AA; SPOC learners: Appendix AD; Completed MOOC learners: Appendix AB; and Completed SPOC/online learners: Appendix AC.

For all delivery modes (B5: M=23.65, SD=16.85, n=683) the learners' total weekly final assessment score showed a slightly higher mean score than MOOC learners alone (B5: M=21.40, SD=16.97, n=543). The proportion of learners who completed the course for all delivery modes (B6: M=0.69, SD=0.41, n=683) also exhibited a higher mean when compared to the MOOC learner group (B6: M=0.66, SD=0.41, n=543). When the completed MOOC learners (B5: M=35.61, SD=7.14, n=288) weekly final assessment scores were compared with those of MOOC learners (B5: M=21.40, SD=16.97, n=543), the mean distribution was considerably higher in learners who completed a MOOC. The B6: % course completed was not assessed for this evaluation as the comparison group included completed MOOC learners. When the SPOC and online learners' weekly final assessment scores (B5: M=38.43, SD=2.99, n=108) were compared to those of completed MOOC learners (B5: M=35.61, SD=7.14, n=288), the mean distribution was again higher for SPOC and online learner groups. The results for B6: % course completed was very similar between the two groups, completed SPOC/online (B6: M=0.97, SD=0.12, n=108) and completed MOOC learners (B6: M=1.00, SD=0.02, n=288) with a very high mean score noted.

4.7.1.2 Retrospective causal-comparative design for weekly quizzes and final assessment scores (H_{13} – H_{17})

An examination of the assessment variables using Mann-Whitney U tests was performed on:

- H_{13}: Learner's Week 1 quiz result
- H_{14}: Learner's Week 2 quiz result
- H_{15}: Learner's Week 3 quiz result
- H_{16}: Learner's Week 4 quiz result
- H_{17}: Learner's final assessment score for all weeks

All 5 variables were statistically significant for all learners, MOOC/SPOC, MOOC, SPOC, and online learning groups when compared to the MOOC 1 control group. H_{13}: Learner's Week 1 quiz result, H_{15}: Learner's Week 3 quiz result and H_{16}: Learner's Week 4 quiz result, were statistically significant for four out of the five groups (Table 14). The final comparison results for H_{13}–H_{17} indicated that there was a difference between students who studied in the SPOC group when compared to the other groups, as displayed in Table 47.

Table 47. *Mann-Whitney U test results for statistically significant assessment hypotheses*

Test*	**Control** (Md=1)	**MOOC/SPOC/ Online** (Md=2)		**MOOC/ SPOC** (Md=2)		**MOOC** (Md=2)		**SPOC** (Md=1)		**Online** (Md=1)		
	n	*n*	*r*	*n*	*r*	*n*	*r*	*n*	*r*	*Md*	*n*	*r*
H_{13}	88	522	.12	429	.12	384	.08	133	.33	2	181	.17
H_{14}	79	455	.08	362	.12	318	.08	123	.50	2	172	.02
H_{15}	77	432	.17	339	.22	295	.18	121	.59	2	170	.08
H_{16}	77	414	.21	322	.33	278	.29	121	.69	2	169	.01
H_{17}	121	683	.06	590	.04	543	.02	103	.21	1	214	.28

Note: Significance level $p<.05$.

Key: H_{13}: Learner's Week 1 quiz result, H_{14}: Learner's Week 2 quiz result, H_{15}: Learner's Week 3 quiz result and H_{16}: Learner's Week 4 quiz result, H_{17}: Learner's final assessment score for all weeks.

Although hypotheses tests (H_{13}–H_{17}) were statistically significant, the effect designation was mainly small. There was a medium effect noted for H_{13}: SPOC and H_{15}: MOOC/SPOC and large effect for H_{15} and H_{16} for SPOC group of learners. This result is reflective of stronger learner progression and higher completions in the SPOC group than for any other group. From this analysis and compared to the other variables, the Week 3 and Week 4 quiz results were the strongest predictors of learner completions. The outcomes for H_{17} show a small effect for the SPOC and online learner groups. This could be reflective of the enrolment process or the individual learner's capabilities on course commencement.

4.7.1.3 Spearman's Rho correlations for weekly assessment and final assessment score results

A Spearman's Rho correlation of B5 Final assessment score and B6 % course completed was conducted to determine if a relationship existed between the two variables. The results are presented in Table 48.

Table 48. *Spearman's rank correlation coefficient between % course completed, final assessment score and total number of discussions for all learners*

Variable		**B6 % Course Completed**	**B5 Weekly Final Assessment Score**
B6 % Course Completed	*rho*	1.000	.790*
	p	.	.000
	n	683	683
B5 Weekly Final Assessment Score	*rho*	.790*	1.000
	p	.000	.
	n	683	683

* Correlation is significant at the 0.01 level (2-tailed).

The relationships between B6 % course completed, and B5 Weekly final assessment score showed a very strong positive correlation between the two variables. This outcome implies that the activities learners performed were directly related to higher completions.

4.7.1.4 Qualitative analysis of MOOC/SPOC learners' perceptions of course assessments

The assessments were only minimally discussed (n=349), however, both a positive and negative assessment experience were provided by these MOOC/SPOC students:

> *"I am learning as much from getting answers wrong, so the quiz design is helpful. There is no fear of wrong answers, which means it's easier to engage."*

> *"Gaining 100% in all assessments is impossible for starters like us, and it's not easy for us to earn the certificate then. Please consider this fact and change the regulations for issuing certifications helping small-time students."*

The online learners (n=25) provided more discussion on their perceptions of assessments with the top 8 and 7 words from the Text Analyser (section 4.3.4) resulting in the statements: *that there were quizzes every week for reinforcement* (4) and *liked that there were quizzes every week* (6). The highest word cloud frequencies (section 4.3.5) presented words such as *quiz* (10), *questions* (8), *assessments* (4), *revisit* (2), and *reviewed* (2).

4.7.2 Learners' capacity to achieve

The learner's capacity to complete a course can be improved by enforcing prerequisite entry requirements, as was the case for the SPOC and online groups in the study. However, MOOC learners were enrolling in a free open course and there were no previous skill or knowledge requirements prior to enrolment. Therefore, a comparison of enrolment pathways between the MOOC and SPOC/online groups was undertaken.

4.7.2.1 Comparison of enrolment pathways for MOOC and SPOC/online

The enrolment pathways are different for MOOC learners and SPOC/online learners. MOOC learners do not have to meet any course prerequisites before they enrol. On the other hand, the CIT courses required the learner to have basic computing skills and to be able to demonstrate basic literacy and numeracy skills. Therefore, SPOC and online learners did have to establish a minimum level of capacity before they enrolled. A crosstab analysis was conducted on MOOC and SPOC/online learner completions and non-completions to determine if there was any relationship between learner outcomes and the enrolment pathway, as shown in Table 49.

Table 49. *Learner outcomes for enrolment pathways*

Variable		**MOOC**	**SPOC/online**	**Totals**
Learners non-completion	Count	255	32	287
	% within	47.0%	22.9%	42.0%
	% of Total	37.3%	4.7%	42.0%
Learners completion	Count	288	108	396
	% within	53.0%	77.1%	58.0%
	% of Total	42.2%	15.8%	58.0%
Totals	Count	543	140	683
	% of Total	79.5%	20.5%	100.0%

A difference was noted in the outcomes for MOOC and SPOC/online groups with over 24% more SPOC/online learners completing the course when compared to the MOOC group. To further explore these differences a Spearman's Rho test was conducted on the same variables with a small positive correlation found between MOOC and SPOC/online groups (rho=.20, n=683, p<.01). These results imply SPOC/online learners are completing their courses more often and this may be an outcome of the prerequisite process enforced for online and SPOC students.

4.7.2.2 VET MOOC learner attributes

VET MOOC learners have different requirements when compared to university MOOC students, as the level of knowledge is less theoretical and more practically orientated for VET learners (Paton, Fluck, et al., 2018; Paton, Scanlan, et al., 2018). Therefore, it was important to examine the type of learner who participates in a VET MOOC. An analysis of the categorical frequencies was conducted on all and completed MOOC learners to build a profile of learners who frequent and finish VET MOOCs. The categorical frequency analysis for MOOC and completed MOOC learners are detailed in Table 50.

Table 50. *VET MOOC learner profile*

Variable		Value	% MOOC	% Completed MOOC
A1	Primary reason for MOOC	I enjoy learning about topics that interest me	48.6	42.7
A2	Type of learner	An active participant	56.4	64.6
A3	Hours per week	Between 2 and 4 hours	40.5	37.5
A4	Level of education	Master's Degree (or equivalent)	23.8	27.4
A5	English primary language	Yes	55.6	60.4
A6	Place living	America	23.9	
		Australia		25.7
A7	Gender	Male	64.6	62.8
A8	Age	25–34	28.0	31.6
A9	Hear about course	From a web search	28.0	28.1
A10	Previous online course	Canvas Network	23.2	
		Other		25.3
A11	Previous online experience	Yes	79.6	79.5
A12	Positive impact of course material	Strongly Agree	48.1	49.8
A13	Positive impact of course activities	Agree	47.9	47.3
A14	Course hours student spends	Between 2 and 4 hours	39.3	39.7
A15	Course recommendations	Very Likely	46.9	47.5
A16	Course overall rating scale	Highest	52.3	54.3
A17	Instructor involvement	I like variety	56.8	56.8
A18	Length canvas course	4–6 weeks	42.3	43.4
A19	Discipline interest	Technology	46.5	45.7
A20	Video interaction for learning	Interactive video content deepened my understanding	26.8	27.7
A21	Video interaction usage	Easy to use	40.0	40.7
A22	Video interaction for enjoyment	I would enjoy using Video Interaction again	33.9	34.3
A23	PDF vs video interaction	I used both Interactive PDFs and Video Interaction	39.0	35.5
A24	Pre-course learner goals	Professional development	39.7	36.8
A25	Pre-course learner experience	Student learning experience	59.3	62.8
A26	Post-course learner goals	Improved knowledge of topic	60.7	61.7
A27	Post-course learner experience	Positive learning experience	70.6	72.4
A28	Participation in discussions	Yes	61.1	81.3
A29	Learners completed course	Yes	53.0	100.0

The qualities of VET MOOC learners were important to consider when developing an understanding of how they achieve. To develop a VET MOOC learner profile, the categorical frequencies for MOOC learners and completed MOOC learners were reviewed (Table 50). A representation of the VET MOOC learner profile based on the average proportions for MOOC learners and completed MOOC learners is illustrated in Figure 25.

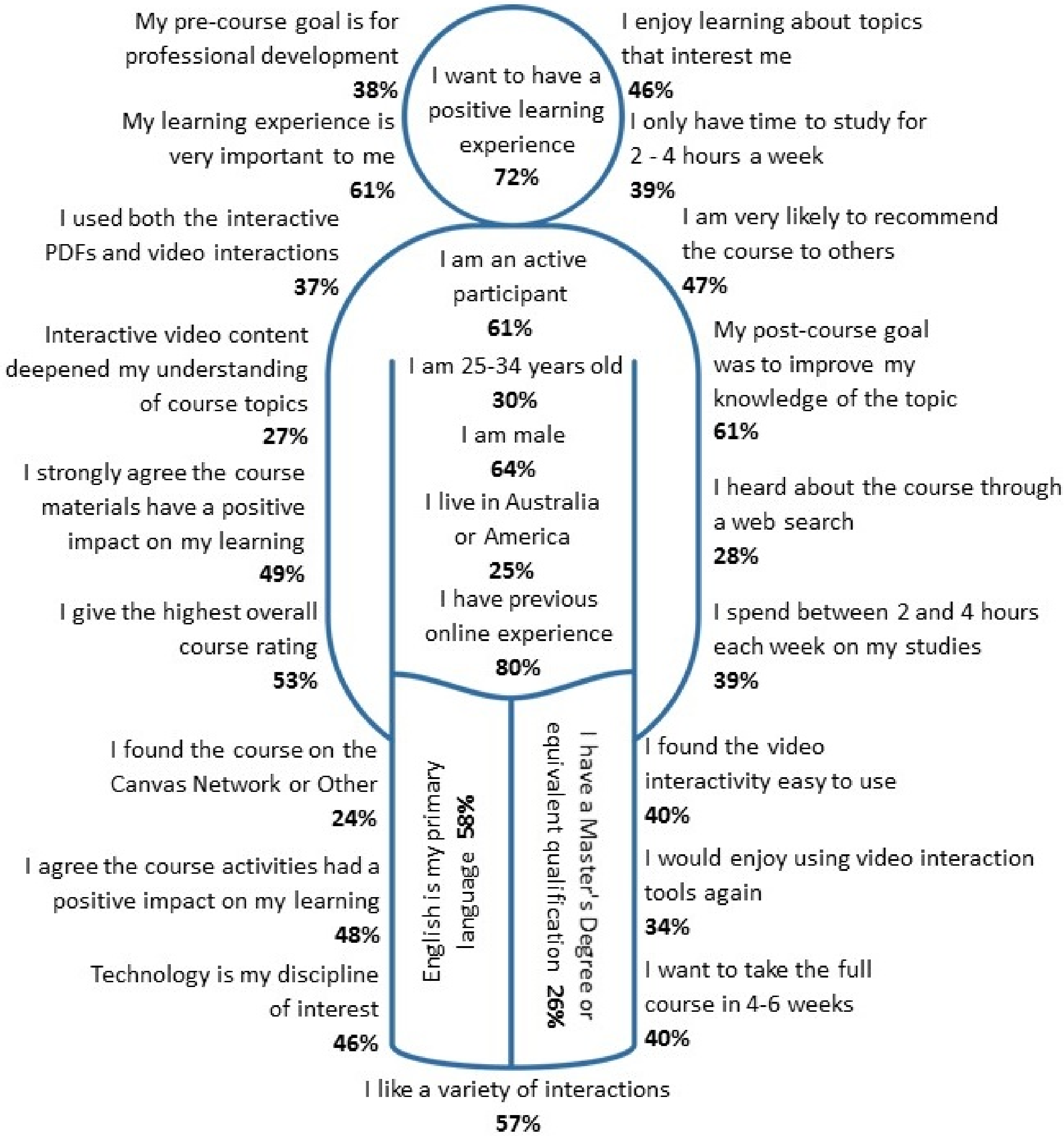


Figure 25. VET MOOC Learner Profile.

The analysis between the categorical frequency variables for each learner who completed the MOOC when compared with the results from all MOOC learners showed similar values but two values of difference were noted across the groups:

- A6 Place living (Australia & South Pacific:America)
- A10 Previous online course (Other:Canvas Network)

In comparison with completed learners the output for all delivery modes (Appendix P), one frequency value was different:

- A4 Level of education (Master's Degree (or equivalent):Completed 4-year college degree)

Another evaluation was conducted on the categorical variables but this time it was for each learner who completed a SPOC or online course (Appendix AC). When compared to completed MOOC learners, 13 variables of difference were found across the two groups:

- A1 Primary reason for MOOC (I hope to gain skills for a new career:I enjoy learning about topics that interest me)
- A4 Level of education (High School or College Preparatory School: Master's Degree or equivalent)
- A7 Gender (Female:Male)
- A9 Hear about course (From the instructor:From a web search)
- A10 Previous online course (CIT:Other)
- A12 Positive impact of course material (Agree:Strongly Agree)
- A15 Course recommendations (8 out of 10:10 out of 10)
- A16 Course overall rating scale (4 out of 5:5 out of 5)
- A19 Discipline interest (Applied Science:Technology)
- A20 Video interaction for learning (Interactive video content made no difference in my learning:Interactive video content deepened my understanding of course topics)
- A22 Video interaction for enjoyment (4 and 5 out of 7:7 out of 7)

- A25 Pre-course learner experience (Course delivery style:Student learning experience)
- A27 Post-course learner experience (Variety of learning stimulus and Positive learning experience:Positive learning experience)

The commonality between the evaluations of MOOC learners when compared to completed MOOC learners was the variables A6 and A10. The geographic location was significant with America and Australia & South Pacific the most commonly represented participants in VET MOOCs. Where the learner had previously studied online was also commonly Canvas or other than school, Coursera, EdX, Udacity, or CIT. The comparison between completed MOOC learners and online/SPOC learners showed a difference of 13 variables. The demographic factor that was uniquely different for SPOC and online learners was the highest level of education which was school or college preparatory school. Females more frequently enrolled in SPOC and online courses but their rating of enjoyment was lower than for the completed MOOC learners.

Mann-Whitney U tests were conducted on the various learner groups for hypotheses H_1–H_8. This was to determine any statistical significance of learner demographic factors, when compared to the MOOC 1 control group. The statistically significant hypotheses tests for each learner group are displayed in Table 51.

Table 51. *Mann-Whitney U test results for statistically significant demographic hypotheses (H_1–H_8)*

Group		Md	n	U	z	p	r	Effect
MOOC 1 control group		1	121					
All learners								
H_4:	Learner's place of residence	2	683	25482.5	-4.47	0.000	0.17	Small
H_7:	Learner's previous online course	2	683	28576.0	-2.79	0.005	0.11	Small
MOOC/SPOC learners								
H_4:	Learner's place of residence	2	590	24275.0	-2.50	0.012	0.10	Small
MOOC learners								
H_2:	Learner's highest level of education	2	546	22110.0	-2.29	0.022	0.10	Small
H_3:	Learners with English as their primary language	2	547	22618.5	-2.21	0.027	0.09	Small
SPOC learners								
H_3:	Learners with English as their primary language	1	168	2024.5	-3.86	0.000	0.30	Small
H_4:	Learner's place of residence	1	168	564.0	-8.47	0.000	0.65	Large
H_5:	Learner's gender	1	168	2006.0	-3.38	0.001	0.26	Small
H_8:	Learner's prior online experience	1	168	2258.0	-2.74	0.006	0.21	Small
Online learners								
H_1:	Learner's primary reason for taking course	1	214	2443.5	-7.23	0.000	0.50	Medium
H_2:	Learner's highest level of education	1	214	4104.5	-3.39	0.001	0.23	Small
H_3:	Learners with English as their primary language	1	214	4633.5	-2.76	0.006	0.19	Small
H_4:	Learner's place of residence	1	214	1195.5	-10.75	0.000	0.74	Very Large
H_5:	Learner's gender	1	214	4519.5	-2.68	0.007	0.18	Small
H_7:	Learner's previous online course	1	214	0.0	-13.09	0.000	0.90	Very Large
H_8:	Learner's prior online experience	1	214	4462.0	-4.52	0.000	0.31	Medium

Note: Variable significance levels *p*<.05 are highlighted in green.

There was statistical significance noted for all hypotheses except age for the online learner group. This could be a reflection of the smaller class sizes, prerequisite entry requirements or associated fees. As most online and SPOC learners resided in Australia and had studied an online course previously, a larger effect designation was expected when compared to MOOC students. The small effect designation for the MOOC group was noted for the learner’s highest level of education (H_2) and learners with English as their primary language (H_3). This indicated that students with a high level of education and those with English as their primary language were more commonly enrolling in the MOOC.

4.7.3 Summary of Research Question 4

The engagement relationships between MOOCs and the structures that encourage learners to interact with the course content can be associated with well-designed assessment instruments and the learners’ capacity to achieve.

An evaluation of assessment instruments was conducted through descriptive analysis of learners’ performance over the four weekly quizzes and on their final weekly assessment score. The mean distribution of weekly quiz scores for all learners was proportionally higher than that for MOOC learners. As expected when compared to completed learners, the mean score distribution was much higher again, although the highest mean was for completed SPOC and online learners. The Mann-Whitney U tests revealed statistical significance ($p<.05$) with the strongest predictor noted after the Week 3 quiz and then again after the Week 4 quiz attempt. There was also statistical significance ($p<.05$) for the learners’ final assessment score for SPOC and online learners when compared to the other learner groups. This could be indicative of the prerequisite entry requirements or a higher level of skills and knowledge in the SPOC and online groups pre-course. Additionally, the Spearman’s Rho test showed a strong positive correlation (rho=.80) for the percentage of course completed and the weekly final assessment scores. This further indicates that SPOC and online learners are carrying out more learning activities and this is reflected in higher completions. Most learners perceived the weekly quizzes were useful as they reinforced their learning and CBT assessment requirements (100% pass with unlimited attempts) were generally achievable.

The learners' capacity to achieve was initially explored through the comparison of enrolment pathways. The Spearman's Rho test for learner non-completions and completions for MOOC and SPOC/online groups showed an increase of 24% in completions for the SPOC/online group. This relationship was statistically significant with a small positive effect (rho=.20, p<.01). Again, the prerequisite element for SPOC and online learners could have contributed to better completions in this group. To further understand the achievement capacity of VET learners, comparison of frequency attributes (A1–A29) and Mann-Whitney U hypothesis tests (H_1–H_8) were conducted on each learner group. MOOC learners and completed MOOC learners showed similar values and frequency percentages, although for completed MOOC learners there was a higher proportion of learners that resided in Australia as opposed to America for MOOC participants. The all group comparison showed learners who completed a 4-year college degree were common in online courses but learners in the MOOC had a master's degree or equivalent. SPOC and online learners' highest level of education was school or college preparatory school, females more frequently enrolled and their enjoyment was generally lower than for completed MOOC learners. Furthermore, the learner demographic (H_1–H_8) hypotheses tests for the online learner group showed statistical significance (p<.05) for the likelihood that smaller class sizes, prerequisite entry requirements, associated fees, Australian residency, and previous online learning experience were all contributors, and this was supported by the high effect designations.

4.8 Research Question 5: How effective is the evolutionary development of a best practice MOOC design in maximising student engagement and retention?

To evaluate this question, action research was used to plan, observe and reflect (Hine, 2013) on multiple repetitions of MOOC, SPOC, and online courses to provide improvement strategies for future VET MOOC developments. The examination was conducted through a cross-sectional study spanning three years and through reflective practices (Kemmis et al., 2013) learners across 11 MOOCs, 6 SPOCs (section 3.3.3.2) and 6 online courses (section 3.3.4.1) were studied. The research was performed in three phases: Phase 1: Testing, Phase 2: Comparison and Phase 3: Evaluation.

The initial testing sought to understand the components of the four research predictors (section 3.3.2), assessment structure, sense of community, course content flow and instructor accessibility, to determine which predictor modification was most likely to promote engagement and retention in MOOCs/SPOCs. Through quantitative inquiry and an action research design, 10 MOOCs (n=2566) and 5 SPOCs (n=66) were evaluated and each predictor was modified as shown in Appendix B. The statistical evaluations of Phase 1: Testing data to determine significant differences between learners, course modes and course iterations against the predictors was conducted. The descriptive analysis of MOOC 1–10 data against the study variables are displayed in Appendix K and for SPOC 1–5 data refer to Appendix L. Then to re-evaluate and triangulate these outcomes, the four factors shown to improve student success were then implemented in Phase 2: Comparison. Phase 3: Evaluation compared the findings from Phase 1 and Phase 2 to determine the factors that best engaged and retained VET MOOC learners.

4.8.1 Phase 1: Testing outcomes

The research predictors for MOOCs and SPOCs were analysed after each iteration and the outcome of the comparison is shown in Table 52.

Table 52. *MOOC and SPOC research predicator comparisons*

Course	Course dates		n	Quiz pass mark	Discussion boards	Content flow	Instructor access-ibility#
MOOC1	Sep-15	Oct-15	121	60%	compulsory	systematic	i1
MOOC2	Nov-15	Dec-15	82	60%	compulsory	systematic	i1
MOOC3	Mar-16	Apr-16	48	60%	compulsory	flexible	i2
MOOC4	May-16	Jun-16	42	60%	compulsory	flexible	i2
MOOC5	Aug-16	Sep-16	40	60%	compulsory	systematic	i3
MOOC6	Oct-16	Nov-16	25	60%	compulsory	flexible	i3
MOOC7	Feb-17	Mar-17	26	100%	optional	systematic	i4
MOOC8	May-17	Jun-17	35	100%	optional	flexible	i4
MOOC9	Aug-17	Sep-17	18	100%	optional	systematic	i5
MOOC10	Oct-17	Nov-17	39	100%	optional	flexible	i5
MOOC (n)			476				
SPOC1	Jul-15	Aug-15	6	60%	compulsory	systematic	i1
SPOC2	Feb-16	Mar-16	2	60%	compulsory	flexible	i2
SPOC3	Jul-16	Aug-16	4	60%	compulsory	systematic	i3
SPOC4	Feb-17	Mar-17	8	100%	optional	flexible	i4
SPOC5	Jul-27	Aug-27	10	100%	optional	systematic	i5
SPOC (n)			30				

i1: Initial welcome and fortnightly article link; i2: Initial welcome, fortnightly article link; i3: Initial welcome, weekly article link and beginning week summary; i4: Initial welcome, weekly article link, beginning week summary and increased teacher chat on content-related discussions; i5: Initial welcome, weekly article link, beginning week summary, increased teacher chat on content-related discussions and motivational emails to learners.

The assessment pass mark for each of the four weekly quizzes in the MOOC was initially set at 60% and two attempts. This provided commonality of research design with the Paton, Scanlan, et al. (2018) study. However, as VET is modelled on validation of learner's competence, this requires the learner to show proficiency against all UoC elements. Hence the quiz pass mark was amended to 100% and unlimited attempts. This change was more reflective of the VET environment and CBT assessment structures; where successful completion of all assessment tasks to a required standard and the opportunity for multiple attempts to achieve the competency is the mandate (Dempsey, 2013).

The discussion board required the weekly participation of learners with four discussion activities to complete. The discussion boards were split into compulsory, where the learner was required to submit a response for formative assessment purposes, or optional. The content release was modified from systematic to flexible, to identify the learners' most preferred study mode. The systematic flow required learners to complete each topic and task sequentially, whereas the flexible flow allowed learners to move between topics as desired. Increasing teacher accessibility and visibility was accomplished by intensifying emails and discussion board contributions after every second MOOC and each SPOC iteration. For ongoing statistical comparisons, MOOC 1 was designated as the control group where the course structure was set at 60% pass mark for assessment quizzes with two attempts, compulsory content-related discussion board activities, systematic content flow, and minimal teacher interactions. The action component for teacher accessibility and visibility were based on the following techniques:

- i1: Initial email to student welcoming them to the course and each fortnight an announcement with a link to a current news/information article is provided.
- i2: Initial welcome email and weekly announcements with article link.
- i3: Initial welcome email, weekly article link, and email at the beginning of the week summarising the upcoming learning materials and tasks.
- i4: Initial welcome email, weekly article link, the beginning of week summary and a teacher comment on each content-related discussion board.
- i5: Initial welcome email, weekly article link, beginning of week summary, teacher content-related discussion board comments, and weekly motivational email to learners on assessment success/failure.

4.8.2 Phase 2: Comparison outcomes

Phase 2: Comparison outcomes provided details of learner completion and success statistics from Phase 1: Testing of MOOC 1–10 and SPOC 1–5 against the research predictors: assessment structure, sense of community, course content flow and instructor accessibility (Appendix M). The attributes that significantly contributed to better learner completions were CBT assessment structures (100% pass mark with unlimited attempts), optional discussion boards, systematic content release of information and when level i4 instructor support was applied, as illustrated in Table 53.

Table 53. *Phase 1 research predictor outcomes for MOOC and SPOC data*

Learner data for MOOCs 1–10 and SPOCs 1–5	**CBT Assessment***	**Optional discussions**	**Systematic Content Flow**	**Instructor Accessibility (i4)^**
Completed/Enrolled	47.0%	47.0%	42.7%	46.1%
Completed/Explored	60.6%	60.6%	52.3%	59.5%
Completed/Started W1T1	71.1%	71.1%	69.1%	76.8%
Success/Enrolled	46.5%	46.5%	42.4%	45.7%
Success/Explored	59.9%	59.9%	51.8%	58.9%
Success/Started W1T1	69.9%	69.9%	68.1%	75.5%

* 100% pass mark with unlimited attempts.

^ i4: Initial welcome email, weekly article link, beginning of week summary and a teacher comment on each content-related discussion board.

The learner completions for online courses 1–5 were also analysed and the descriptive statistics against the study variables are shown in Appendix N. Due to the structure of the CIT online environment and the variation in course structure, only three research predictors were compared to the MOOC and SPOC data, these were: CBT assessment structures (100% pass mark with unlimited attempts), optional discussions, and flexible content release. The outcomes of online 1–5 courses are displayed in Table 54.

Table 54. *Phase 1 research predictor outcomes for online data*

Learner data for online delivered courses 1–5	**CBT Assessment***	**Optional discussions**	**Systematic Content Flow**
Completed/Enrolled	47.9%	48.8%	48.8%
Completed/Explored	73.3%	86.0%	86.0%
Completed/Started W1T1	78.5%	86.0%	86.0%
Success/Enrolled	47.2%	48.0%	48.0%
Success/Explored	71.3%	82.7%	82.7%
Success/Started W1T1	76.3%	82.7%	82.7%

* 100% pass mark with unlimited attempts.

Further Independent-Samples Kruskal-Wallis Tests were conducted on all groups against each research predictor to identify any statistical significance and displayed in Table 55.

Table 55. *Phase 1 Kruskal-Wallis tests for assessment and discussion variables*

Learner data for MOOCs 1–10, SPOCs 1–5, online 1–5	**Kruskal-Wallis test mean**	**SD**	***n***	***p***
Completed/Enrolled for assessment	5.90	0.28	20	.02
Completed/Explored for assessment	7.28	0.27	20	.01
Success/Enrolled for assessment	5.02	0.28	20	.03
Success/Explored for assessment	6.49	0.27	20	.01
Completed/Enrolled for discussion	5.90	0.28	20	.02
Completed/Explored for discussion	7.28	0.27	20	.01
Success/Enrolled for discussion	5.02	0.28	20	.03
Success/Explored for discussion	6.49	0.27	20	.01

The key attributes from the research predictor examinations found there was statistical significance in CBT assessments that had a 100% pass mark with unlimited attempts and optional discussion boards. Correspondingly, the systematic release of content and the use of level i4 instructor support (sends an initial welcome post to each learner, weekly links to interesting articles, beginning of week summary of learning tasks and a teacher comment on each content-related discussion board) also contributed to better learner completions. These outcomes formed the structure for MOOC 11 and SPOC 6 and the analysis was conducted in Phase 3: Evaluation. The descriptive analysis of MOOC 11 (a–e), SPOC 6 and online 6 groups are presented in Appendix O.

4.8.3 Phase 3: Evaluation outcomes

The third phase evaluated the Phase 2 data from MOOC 11 (a–e), SPOC 6 and online 6 data (Appendix O) against the Phase 1 results (MOOC 1–10: Appendix K, SPOC 1–5: Appendix L, online 1–5: Appendix N) to triangulate the completion findings. The data differences from the Phase 1 and Phase 2 examinations revealed (Appendix M) the four key factors were CBT assessment requirements (100% pass mark with unlimited attempts), optional discussion boards, systematic content release and level i4 instructor support (initial welcome email to each learner, weekly links to interesting articles, beginning of week summary of learning tasks and a teacher comment on each content-related discussion board), these contributed to 11% more learners who started W1T1 and then went on to complete MOOC 11 or SPOC 6, as outlined in Table 56.

Table 56. *Comparison of MOOC and SPOC data differences for Phase 1 and Phase 2*

Variable	**Phase 1 data total**	**Phase 2 data total**	**Differences for Phase 2 and Phase 1**
1 Learners enrolled	692	461	-231
2 Learners explored	424	299	-125
3 Learners started W1T1	262	137	-125
4 Learners completed course	169	104	-65
5 Learners successfully completed course	166	104	-62
6 Learners failed course	4	0	-4
Completed/Started W1T1	72.03%	83.50%	11.44%
Success/Started W1T1	70.85%	83.50%	12.61%
Failed/Started W1T1	1.18%	0.00%	-1.18%

The online learner data showed slightly higher proportional scores across the study variables, as displayed in Table 57.

Table 57. *Comparison of online 1–6 data differences and Phase 2 MOOC 11 and SPOC 6*

Variable	**Phase 2 data total**	**Online data total**	**Difference for Online and Phase 2**
Completed/Started W1T1	83.5%	84.72%	1.22%
Success/Started W1T1	83.5%	81.94%	-1.56%

Although Success/Started W1T1 was proportionally lower (1.5%) in online delivered courses when compared to MOOC 11 and SPOC 6, overall online courses scored proportionally higher in comparison with MOOC and SPOC courses.

Mann-Whitney U tests were then conducted on the completion data for MOOC 1–11 and SPOC 1–6 learners to determine if learning environment affected completions. The results are displayed in Table 58.

Table 58. *Mann-Whitney U test results for MOOC 1–11 and SPOC 1–6 learner data*

Variable	**Md**	***n***	**U**	***p***	***r***
1 Learners enrolled	104	21	0.0	.00	.76
2 Learners explored	74	21	2.0	.00	.73
3 Learners started W1T1	48	21	13.0	.01	.54
4 Learners completed course	30	21	16.5	.03	.49
5 Learners successfully completed course	30	21	16.5	.03	.49
6 Learners failed course	0	21	27.0	.09	.38

All variables were statistically significant with a medium to very large effect. This outcome suggests that the SPOC learning environment was more conducive to learner completions.

Mann-Whitney U tests were also conducted on MOOC 1–11 and online 1–6 to determine the effect of each learning environment on the corresponding study variables, as shown in Table 59.

Table 59. *Mann-Whitney U test results for MOOC 1–11 and online 1–6 learner data*

Variable	**Md**	***n***	**U**	***p***	***r***
1 Learners enrolled	104	21	3.0	.00	.71
2 Learners explored	74	21	6.5	.00	.65
3 Learners started W1T1	51	21	18.5	.04	.45
4 Learners completed course	33	21	25.5	.13	.33
5 Learners successfully completed course	31	21	25.5	.13	.33
6 Learners failed course	0	21	32.0	.23	.26

The statistical significance and effect size designations of these variables are representative of the student numbers on course commencement being considerably different between MOOC and online learners. The MOOC group is naturally attracting a much higher number of students as it has a global presence and enrolment is free.

4.8.4 Action Research Outcomes

The action research for this study evaluated four key research predictors: assessment structure, sense of community, course content flow and instructor accessibility (section 3.3.2), to examine engagement and retention strategies. These were designated as key factors based on the prior work carried out by authors researching engagement and retention in MOOCs and VET online courses (see, for example, Bruff et al., 2013; Admiraal et al., 2015; Hew, 2014; Kellogg et al., 2014). For online courses, three research predictors were compared to MOOC and SPOC data to determine significance. The outcomes from Phase 1: Testing and Phase 2: Comparison, showed learner completions were improved when CBT assessment requirements (100% pass mark with unlimited attempts), optional discussions, systematic content release, and level i4 instructor support was instigated. Level i4 instructor support included an initial welcome post, weekly article links, beginning of week summary and teacher comments on content-related discussion boards (Table 53). A Kruskal-Wallis test was then conducted and found statistical significance in course completions when CBT assessments that had a 100% pass mark with unlimited attempts and optional discussion boards were implemented (Table 55). These outcomes formed the structure for MOOC 11 and SPOC 6 and were evaluated in Phase 3 of the study. From the literature evaluation undertaken in Chapter 2, there were no available research studies that evaluated these specific course attributes, therefore this section cannot compare with the finding from other literary sources.

Phase 3: Evaluation found higher proportional scores for the Phase 2 MOOC/SPOC learner group when compared to the Phase 1 data and after the research predictors were implemented. Once the significant research predictors, CBT assessment requirements with 100% pass mark and unlimited attempts, optional discussion boards, systematic content release, and level i4 instructor support was implemented, an 11% increase was noted in learners who commenced the Week 1 Topic 1 activity.

Mann-Whitney U tests to determine if completions were affected by the learning environment were conducted. The tests were statistically significant with a large effect for 3 Learners started W1T1 and a medium effect for 5 Learners successfully completed course and 6 Learners failed course (Table 58). This outcome suggests that the SPOC learning environment was more conducive to learner completions in comparison to MOOC learners. However, the results for the Mann-Whitney U test for MOOC and online completions were inconclusive.

An evaluation of the significant and non-significant variables shows that the learners who took a course which incorporated the significant variables were 6% more likely to complete and 8% more successful than those students who took the course with non-significant variables. For a further comparison with the Phase 1 group, but this time for the significant variables, a similar result was found with 6% more likely to complete and 7% of learners more sucessful, as displayed in Table 60.

Table 60. *Evaluation of learner completions and non-completions for significant and non-significant research predictors*

Variables	Total MOOC 11, SPOC 6 & Online 6	Average Phase 1 significant variables*	Average Phase 1 non-significant variables^
Completed/Started W1T1	72%	72%	66%
Success/Started W1T1	72%	71%	64%
Failed/Started W1T1	0%	1%	1%

* Significant variables include: CBT assessment requirements (100% pass mark with unlimited attempts), optional discussions, systematic content release and instructor accessibility (i4#)

^ Non-significant variables include: 60% pass mark with two attempts, compulsory discussions, flexible content release and instructor accessibility (i1#, i2#, i3#, i5#)

\# i1: Initial welcome and fortnightly article link; i2: Initial welcome, fortnightly article link; i3: Initial welcome, weekly article link and beginning week summary; i4: Initial welcome, weekly article link, beginning week summary and increased teacher chat on content-related discussions; i5: Initial welcome, weekly article link, beginning week summary, increased teacher chat on content-related discussions and motivational emails to learners.

4.8.4.1 Assessment structure

When the assessment pass mark was set to CBT assessment measures (100% pass with unlimited attempts), 11% more learners who commenced (started W1T1) went on to complete MOOC 11 or SPOC 6 (Table 56). When MOOC 11 and SPOC 6 were compared to the online group, a higher mean score was found in the number of learners and 22.4% more students completed. These findings suggest that more learners finished the course when assessments were aligned to vocational CBT assessment measures.

This was confirmed by the proportional evaluation of the research predictor: assessment for Phase 2 group (MOOC 11, SPOC 6 & online 6) when compared to Phase 1: 60% pass mark group. The Phase 2 assessment group showed that 6% of learners were more successful and 8% completed. Similar results were also shown for the comparison of Phase 1: CBT Assessments (100%) group and Phase 1: 60% group, although the Phase 2 group had on average a slightly higher completion rate, as displayed in Table 61.

Table 61. *Evaluation of learner completions and non-completions for research predictor: assessment*

Variables	Total MOOC 11, SPOC 6 & online 6	Total Phase 1 CBT Assessments*	Total Phase 1 Pass mark 60%^
Completed/Started W1T1	72%	71%	66%
Success/Started W1T1	72%	70%	64%
Failed/Started W1T1	0%	1%	1%

* Learner was fully competent and gained a 100% pass mark in unlimited attempts for each assessment

^ Learner gained a 60% pass mark in two attempts for each assessment

4.8.4.2 Sense of community

The discussion requirements for learners were alternated between optional and compulsory participation to determine if this had an impact on learner engagement and retention. When Phase 1: compulsory group was compared to the Phase 2 group (MOOC 11, SPOC 6, and online 6) a 6% increase in learner completions and 8% in learners who succeeded was the outcome. Once again there was a resemblance between the Phase 2 group and Phase 1: optional groups, as presented in Table 62.

Table 62. *Evaluation of learner completions and non-completions for research predictor: discussion*

Variables	Total MOOC 11, SPOC 6 & online 6	Total Phase 1 Discussion Optional	Total Phase 1 Discussion Compulsory
Completed/Started W1T1	72%	71%	66%
Success/Started W1T1	72%	70%	64%
Failed/Started W1T1	0%	1%	1%

Although learners preferred the choice of optional discussions, it was seen that posting participation declined by 40% in this group.

4.8.4.3 Course content flow

The course content flow between systematic and flexible content release data was evaluated and the results revealed that for the Phase 2 group (MOOC 11, SPOC 6, and online 6) there was a 6% increase in learners who completed and 7% in successful learners when compared to the Phase 1 flexible group. A similar outcome was seen with the Phase 2 group and Phase 1 systematic content release group, although in this instance the Phase 2 group only did slightly better with an extra 4% of learners completing. The outcomes are displayed in Table 63.

Table 63. *Evaluation of learner completions and non-completions for research predictor: content flow*

Variables	**Total MOOC 11, SPOC 6 & online 6**	**Total Phase 1 Content flow Systematic**	**Total Phase 1 Content flow Flexible**
Completed/Started W1T1	72%	69%	66%
Success/Started W1T1	72%	68%	65%
Failed/Started W1T1	0%	1%	2%

This result was a surprise as a flexible release of course information was presumed to be more suited to learners studying fully online in technology-rich courses. However, as this research found, an online course that has strong and reliable course design structures can improve engagement and leads to better learner completions. Therefore, content release issues are slightly diminished when course design is of a high order.

4.8.4.4 Instructor accessibility

The instructor's role in a technology-rich online course provides the learner with valuable guidance on the learning process. Effective communication by the instructor assists in humanising the online experience. However, there is a point where the teacher overburdens the students with information and feedback. Five levels of instructor support were examined throughout the phase investigations, and these were:

i1: Initial welcome and fortnightly article link.

i2: Initial welcome, fortnightly article link.

i3: Initial welcome, weekly article link and beginning week summary.

i4: Initial welcome, weekly article link, beginning week summary and increased teacher chat on content-related discussions.

i5: Initial welcome, weekly article link, beginning week summary, increased teacher chat on content-related discussions and motivational emails to learners.

Level i4 was shown to be the most effective level of instructor support and the one that promoted learners to engage without feeling harassed or overloaded. The evaluation of the completions and i4 instructor support for Phase 2 (MOOC 11, SPOC 6, and online 6), when compared with the data from the other four instructor support levels from Phase 1, a 7% increase in completions and 8% increase in student success was noted. The evaluation data for this analysis are presented in Table 64.

Table 64. *Evaluation of learner completions and non-completions for research predictor: instructor accessibility*

Variables	**Total MOOC 11, SPOC 6 & online 6**	**Total Phase 1 Instructor Accessibility (i4)***	**Average Phase 1 Instructor Accessibility (i1, i2, i3, i5)***
Completed/Started W1T1	72%	77%	65%
Success/Started W1T1	72%	76%	64%
Failed/Started W1T1	0%	1%	2%

* i1: Initial welcome and fortnightly article link; i2: Initial welcome, fortnightly article link; i3: Initial welcome, weekly article link and beginning week summary; i4: Initial welcome, weekly article link, beginning week summary and increased teacher chat on content-related discussions; i5: Initial welcome, weekly article link, beginning week summary, increased teacher chat on content-related discussions and motivational emails to learners.

4.8.5 Summary of Research Question 5

The action research component of this study specifically evaluated the evolutionary development of learner groups based on four research predictors (Figure 6) to identify the best practice strategies that maximised student engagement and retention. The research predictors for Phase 1: Testing varied for each learner group according to: assessment structure where the pass mark was 60% with two attempts or 100% with unlimited attempts (CBT assessment); sense of community where discussion boards were either compulsory or optional; course content flow which alternated between systematic or flexible; and instructor accessibility. Instructor accessibility compared five techniques, i1: initial welcome and fortnightly article link, i2: Initial welcome, fortnightly article link, i3: Initial welcome, weekly article link and beginning week summary, i4: Initial welcome, weekly article link, beginning week summary and increased teacher chat on content-related discussions, i5: Initial welcome, weekly article link, beginning week summary, increased teacher chat on content-related discussions and motivational emails to learners.

Phase 2: Comparison outcomes compared the results for MOOCs 1–10 and SPOCs 1–5 against the research predictors. The attributes that contributed to better learner completions for MOOC learners that Completed/Started W1T1 were CBT assessment requirements (100% pass mark with unlimited attempts) (71%), optional discussion boards (71%), systematic content release of information (69.1%), and when the instructor used technique i4 (77%). The online learners showed similar outcomes when compared to the three research predictors: CBT assessments (79%), optional discussion boards (86%), and systematic content release of information (86%). The Kruskal-Wallis tests revealed no statistical significance for sense of community, instructor accessibility or learners who Completed/Started W1T1. However, there was statistical significance (p<.05) found for CBT assessment and optional discussions for the Completed:Success/Enrolled and Completed:Success/ Explored variables.

The last phase, Phase 3: Evaluation outcomes, actioned the four key attributes from Phase 2 in MOOC 11, SPOC 6 and online 6 to triangulate these outcomes and provide comparison data for Phase 1. When MOOC 11 and SPOC 6 incorporated CBT assessment requirements (100% pass mark with unlimited attempts), optional discussion boards, systematic content release of information and instructor technique i4, an 11% increase in learners who started W1T1 and completed the course was seen. Online learners scored proportionally higher with 12% of learners who Started W1T1 completing the course. A comparison was then conducted on completions to determine if they were affected by the learning environment. Statistical significance ($p<.05$) was found between MOOCs and SPOCs with a large effect for learners who Started W1T1 and medium effect for learners who completed the course. This suggests that SPOC learning contributed more favourably to learner completions than the MOOC environment. When MOOC learning was compared to online delivery, statistical significance ($p<.05$) was also noted with a medium effect for learners who Started W1T1 and this implies online learners were more likely to commence the first learning topic than were MOOC learners.

5 Discussion

5.1 Introduction

This chapter synthesises the research findings and links them to the systematic literature review to explicate the VOOM Model. The SLR engagement and retention tree (Figure 3) was initially presented in the literature review as an overview of engagement and retention strategies revealed by academic scholars. The theoretical framework (Figure 4) then established the focus for the critical examination of the findings with relevance to the key themes, underlying component categories and practical functional approaches that were identified as promoting engagement and retention in VET MOOCs (Paton, Fluck, et al., 2018). The quantitative and qualitative data that was collected from MOOC, SPOC, and online learners during the study were then coded against the conceptual framework and functional approaches (Table 5 and Table 6). Together, with the research suggestions from the literature review (section 2.11), these formed the basis for the study with the aim of answering these five research questions:

1. What are Vocational Education and Training (VET) students' perceptions of MOOC learning? (section 5.2)
2. What are the factors identified in student engagement and retention for VET MOOCs? (section 5.3)
3. What are the relationships between student retention in VET MOOCs, SPOCs, and online environments? (section 5.4)
4. What are the relationships between student engagement in VET MOOCs, SPOCs, and online environments? (section 5.5)
5. How effective is the evolutionary development of a best practice MOOC design in maximising student engagement and retention? (section 5.6)

This chapter now relates the answers to each research question to the literature from Chapter 2. Please note that the statistical baselines included in this chapter are grounded on the variable, 3 Learners started W1T1, as recommended by Paton, Scanlan, et al. (2018) with their results explored in section 3.3.3.3.

5.2 Research Question 1: What are the relationships between student retention in VET MOOCs, SPOCs, and online environments?

Learners' perceptions are a critical element of engagement and retention in MOOCs. MOOCs as a model of educational delivery provides a wide range of learning opportunities for students on a worldwide scale to develop skills and knowledge through learner interactions (Greene et al., 1989) but retaining students can be a challenge (de Freitas et al., 2015). Understanding VET students' perceptions of their MOOC studies by investigating what motivated them to persist and finish their course was a research direction from the literature review. Therefore, research question 1 was founded on exploring three learners' perception attributes that link to ongoing engagement and retention. These were:

- Learners' sense of community through collaborative mechanisms
- Enticement of certification and academic pathways
- Desire and influence of free learning

5.2.1 Learners' sense of community through collaborative mechanisms

This research found a key component of building a learning community was incorporating collaborative mechanisms, such as discussion boards and social networking sites into online courses. These encouraged student/teacher interactions and dialogue sharing as suggested by Kellogg et al. (2014). In this study, 61% of MOOC students contributed to discussions in contrast to Campbell et al.'s (2014) findings of university MOOCs, where on average 13%

of learners contributed to discussion forums. Campbell et al.'s (2014) suggestion that discussion forums are an academic learning tool and cultivated collaboration was confirmed by this study with an average of 69% of learners participating in online chat. A notable improvement in learner retention was found with 81% of MOOC learners who posted to at least one discussion board successfully finishing the course. This further supports Hew’s (2014) and Barak’s (2016) findings that discussion boards stimulate knowledge transference which strengthens learner engagement and retention. The most frequented discussion board was Introduce Yourself where 65% of students contributed posts which indicates a strong willingness by learners to commence communication with others quite early in the course. Additionally, as Yates et al. (2014), Barak et al. (2016), Hew (2014) and Veletsianos et al. (2015) studies found in university courses, the inclusion of quality communication tools fostered a sense of community. Similarly, the learning community was an important aspect of this study with 71% of learners requiring some social functionality and a strong positive correlation for increased posting activity improving course performance. Although when MOOCs/SPOCs had compulsory discussions, 69% of learners posted and when discussion participation was non-compulsory there was still quite a high posting rate of 54%. This study also found that the decline in discussion postings across the four weeks was 7% for completed participants, with this decline doubling for all learners. This is an interesting finding as it demonstrates that even when discussion forums were not mandatory, VET MOOC learners were inclined to post considerably more often than university sector students. However, once optional discussions were prescribed there was a much higher posting decline of 40%. Although this is a notable decline, students in this study preferred optional content-related discussion boards where they could initiate conversations when they desired. This strategy had the effect of reducing writing anxiety which, in turn, improved learner engagement.

Veletsianos et al. (2015) suggested social networking tools strengthen learner interactions and broaden topic knowledge. Pilli and Admiraal (2017) recommend integrating social media tools into MOOCs to enable learner collaboration and for increased student success. However, as the discussions were negligible in the Facebook group and twitter posts could not be analysed, the use of this tool for enhancing collaboration and increasing students' completions was inconclusive. Although, this study did show the inclusion of alternative communication tools was perceived as useful by learners.

5.2.2 Enticement of certification and academic pathways

The learners' perception of a certificate on course completion and the opportunities to further academic pathways were found to be significant factors in ongoing engagement and retention. This is in contrast to Radford et al.'s (2014) assertions where certification only adds personal value to the individual. In Dillahunt et al.'s (2014) study, the learners who enrolled in university courses offering a certificate (37%) were twice as likely to finish than those in courses that did not provide an award on completion (19%). Furthermore, Admiraal et al.'s (2015) study found better results and higher completions from students studying in certified courses. The average completion for all learners in this study was 58% which is a substantial increase in the number of completed VET learners gaining a certificate on course completion when compared to Dillahunt et al.'s results. These results also lend support to Green et al.'s (2015) and Hone & El Said's (2016) claims that even though the certificate can only be representative of course achievement and not an academic qualification, the added advantage of offering micro-credentials (Hofer et al., 2018) is a stronger incentive for learners to achieve the course requirements. Campbell et al. (2014) and Radford et al. (2014) reported most students who studied a MOOC were pursuing knowledge co-construction for a professional development application and a certificate was an important component of this. Likewise, this study supports these findings as 42% of learners enrolled for professional and career development reasons and 17% of learner comments were directly related to gaining a certificate while 48 times students positively referred to certification. The certification was even more important to SPOC learners with 19% providing remarks about achieving one. Although a factor for this increase could be the compulsory submission of the MOOC certificate prior to the SPOC student accessing the final summative assessment for the Monitor Biometric Equipment and Systems unit. Furthermore, this study found that while providing micro-credentials improved completions, the opportunities of further study pathways were additionally important to learners and enticed them to finish (Green et al., 2015; Hone & El Said, 2016). Clow (2013) warns that MOOCs alone cannot replace the value of traditional university structures and although this is true, there are standards as outlined by Paton, Scanlan, et al. (2018) where MOOC content and assessments structured on UoCs and utilising skills recognition can guide learners towards entry into a full institutional qualification. These findings validate the importance of a MOOC certificate on course completion and providing further study pathways via skills recognition or through micro-credentials into institutional qualifications to facilitate better learner retention.

5.2.3 Desire and influence of free learning

The learners desire to study a free course and finish was underpinned by their initial motivation to enrol. Campbell et al. (2014), Radford et al. (2014) and Milligan et al. (2016) found that learners who took a MOOC for personal interest (self-efficacy) or professional development (goal setting) were more likely to be retained for the whole course. These were clarified by this study as the online learners whose pre-course goals were professional development or personal interest, 81% participated in discussions more often and 37% were more likely to complete. Also, Campbell et al. (2014) and Gorky (2014) identified learner satisfaction is a substantial factor for retaining learners and was confirmed by this study. Post-course MOOC learners perceived a positive learning experience was a strong motivator for their ongoing course progression and this was reflected in 43% more learners completing. Additionally, an analysis of learners' perceptions from their rating selections for ongoing course recommendations and overall course ratings revealed that 49% of learners gave the top recommendations for both which further supports Gorky's (2014) research. Although it should be noted that even though SPOC students on average performed better than MOOC students, their perceptions of a positive course experience, being a motivator, was less favourable. This could be an outcome of the transitioning between course learning platforms (Canvas and eLearn) causing confusion or eLearn which is harder to navigate and less user-friendly than Canvas. Even so, over 41% of SPOC learners still bestowed the highest overall course star rating. These findings advocate for online courses to be professionally focused with visible job outcomes to stimulated stronger course engagement.

Hidden fees and costs for exams or certification in MOOCs were contributing factors to student dissatisfaction and higher withdrawals and issues identified by Impey et al. (2015), Bali (2014) and Hew (2014). As the CIT MOOC was entirely free, these concerns could not be statistically correlated. However, learners did provide references to the importance of free vs fee MOOCs with their perceptions summed up by these comments: *“However, what has put me off doing a course such as this has been cost, I am truly grateful for this one”* and “… *doing it for free and at my own time and anywhere seems to be a very good opportunity that is very hard to resist”.*

5.3 Research Question 2: What are the factors identified in student engagement and retention for VET MOOCs?

Engaging and retaining learners in technology-rich online learning environments is a contentious issue. The number of learners who complete university MOOCs is considered relatively low and documented as being around 12%–36% (Dillahunt et al., 2014; Jordan, 2014; Perna et al., 2014). This research question, as suggested by the literature review, concentrated on evaluating the functional approaches and component categories to correlate student engagement and retention factors. The comparison factors were:

- Instructor’s commitment to globally contextualised communication
- Learner participation coupled with engagement patterns
- Impact of delivery preferences on engagement and retention

5.3.1 Instructor’s commitment to globally contextualised communication

The instructor's commitment to meaningful sustained communications with online students has been shown to enhance learner retention and improve learner satisfaction (Hew, 2014; Pilli & Admiraal, 2017). This study found that learners were happy to interact with the instructor 10% of the time. They acknowledged the *teacher* 91 times and *instructor* 17 times in their comments which implies that the teacher was a co-constructor and the humanising factor in their learning. Hew (2014) suggests most learners need encouragement for sustainable and ongoing learning to take place. This was confirmed by the results of this study, as 43% of learners who used the course communication tools to interact with peers and the instructor successfully finished. Although, on average 24% of learners used one or more discussion boards. Hew (2014) additionally found that engagement was promoted when teaching staff were accessible and showed passion in their course instruction. From this study, the lines of communication were more strongly encouraged, and completions increased by 7% when four levels of support were implemented by the instructor. These included an initial welcome, weekly article links, beginning of week summary and teacher chat on optional content-related discussion boards. These techniques promoted learners to engage without feeling harassed or overloaded. They also demonstrated to the learner the instructor was interested in their progress and reminded the learner the instructor was a real person. These outcomes suggest instructors of online courses should be visible and accessible for ongoing learner engagement and achievable by using the four levels of instructor support classified by this study.

Khalil and Ebner (2013) warn time zone variances can impede timely teacher responses and the opportunities for the instructor to communicate across time zones with a large group of students is problematic (Fournier et al., 2014). Particularly without flexible timetabling (Bruff et al., 2013) and/or other avenues for the learner to interact with or gain information from when the instructor is not online. However, Bali (2014) found asynchronous communication could be a positive factor in retaining students. This study also found asynchronous discussion boards such as Technical Help, General Chat, and Course Q&A were useful for mediating specific discussions, with the most frequented forum being Introduce Yourself. The flexibility of the asynchronous chat enabled learners to communicate without time zone restrictions but for the instructor, this made timely responses difficult. Therefore, notification on the timeframe for the instructor’s return responses (for example within 48 hours) was the technique used to alleviate learner frustration while they waited for a reply.

5.3.2 Learner participation coupled with engagement patterns

Learner classifications have been summarised by Whitmer, Scholrring, and Miley (2015), Veletsianos et al. (2015), and Barak et al. (2016) in an attempt to categorise learners by the way in which they interact with online courses. This research took their model a step further and evaluated learner participation based on the learner self-classifying themselves pre-course as either active, passive, observer or drop-in. Active participants had a steady flow of activity for the first 60% of the course and passive learners the first 40%, but observers and drop-in learners had relatively low activity completions. However, all classifications showed improvement in activity for the last 10% of the course. Whitmer, Scholrring, and Miley's (2015), Veletsianos's et al. (2015), and Barak's et al. (2016) studies also found consistency between learner activity and the learner classifications but this examination found an additional link between learner engagement and self-classifications with 71% of all learners selecting their correct learner classification type, even before they commenced the course. Based on these findings, further research into learner self-classifications and how they relate to learner activity progression and learner completions is suggested. Learner participation was further explored and a regression model determined that activity completion was 69% higher in completed learners with the average activity ranging from 16% to 84% although the model was only 18% reflective of this data. However, the non-completer model was 79% more representative of the data with peaks of higher activity in the first week and then for each assessment activity. When this was compared to the Whitmer, Scholrring, and Miley (2015) regression model of 4% for completers, the model for this study had a much closer fit with 18% for completers and 79% for non-completers which makes the outcomes of the direct logic regression more plausible. Additionally, Admiraal et al.'s (2015) study found successful completions of quiz 1 was the strongest predictor that a student would complete. However, in this study, Week 1 Module 1, Week 3 Topic 1 and Week 4 Topic 3 were the strongest predictors with learners over 19 times more likely to succeed after completing those activities. Therefore, interesting and stimulating course materials, especially in the first week, reduces learners dropping out early and encourages ongoing engagement as there is heightened learner enjoyment from the course onset.

Another notable effect on engagement and retention was through learner demographic, learner participation, and learner course rating factors. The final SEM (Structured Equation Modelling) showed engagement was 13% more predictive of course achievement than retention but the effect of engagement on retention was indirectly affected by the learner course rating factors. Furthermore, when the course incorporated easy to use video interactive learning tools, the student's enjoyment was enhanced and this helped to reinforce information retention. Wang and Baker's (2015) study found a similar finding where the student's interest in the content was more important to the learner than completing the course. Therefore, higher levels of engagement can be achieved when a variety of learning resources (Downes, 2010) and interactive or gamified learning tasks (Gamage et al., 2014) are used in the learning process. However, course completion solely based on student enjoyment was not seen as conditional and the course also needed to fit within the time constraints of the learner and the learning process needed to be perceived by the learner as achievable for improved retention. Engle et al.'s (2015) study evaluated the same three traits and she found that dedicated study time, an active learner type, and previous online experience were significant for ongoing engagement. These outcomes suggest that retention is enhanced, learner interest maintained and retention of knowledge and skills for impending assessments better when interactive learning tasks are incorporated into the course design.

Furthermore, the study by de Freitas et al. (2015) confirmed there was improved completion rates when learners' comments were positive and a course rating score of 90% was given. This gives credence to the results from the final SEM model for this study. As after variation reductions, a 10% improvement in learner completions was achieved but this improvement was reliant on the learner giving a high course rating, high course recommendations score, correctly self-classified as an active participant, dedicating 2-4 hours of time to study each week, and possessing previous online study experience. Also, the course needed to incorporate beneficial, easy to use and enjoyable interactive video technologies. The final model also reinforced Gorky's (2014, p.18) definition of engagement and retention where "learners' judgement of success" and the importance of "ongoing recommendations to others" are his measures of retention but as Gorky's definition does not provide a sufficiently reliable measure of student judgement, this study proposes an enhanced version: *Engagement and retention is the learners' judgement of success through improved knowledge and skills, and their ongoing recommendations to others*.

5.3.3 Impact of delivery preferences on engagement and retention

The delivery factors that can impede or enhance student engagement and retention are the hours a learner allocates to study, the length of time they actually spend on their studies, and the overall course length. As studying has a major impact on an individual's life and as it takes a certain amount of commitment to finish any type of learning, it was important to explore the time patterns of the online learner. This study found that the hours a student perceived to spend was consistent with what they actually spent in study time. Additionally, the days to complete the MOOC was between 1 day and 55 days with the average being 15 days. This outcome is interesting as 14% more students completed the MOOC when the course had no specific finish date, although most learners had no issues completing within the course's recommended timeframe of four weeks. These findings further add credibility to Jordan's (2014, 2015) research where she found enrolment numbers and completion rates decreased over the length of the course and predicted completion rates were significantly affected by courses with longer timeframes. So, when learners allocate time set around the recommended course hours, the course has condensed study duration (2-4 hours of study each week) and when the course length has a relatively short timeframe (2-6 weeks in duration), learners are more likely to be retained until completion. However, the published hours need to be a realistic measure of the actual student workload for the course.

5.4 Research Question 3: What are the relationships between student retention in VET MOOCs, SPOCs, and online environments?

The design of technology-rich online courses and the underpinning theory that supports the course andragogy have a strong influence on the length of time a learner is retained in the course. The main aim of this research question, as revealed by the literature review, was to examine the aspects that promoted student retention across the three online environments to provide guidance on how VET learners are best retained.

5.4.1 Quality instructional course design blending delivery topologies

Milligan et al. (2016) found the learning environment is the skeleton that outlines the learning process with meaningful learning stimuli and innovative delivery strategies needed to promote ongoing student persistence. This study found a combination of connectivism learning theory through collaborative communication strategies combined with an e-Learning topology and andragogical concepts, enhanced student learning and was a beneficial retention strategy. Pilli & Admiraal's (2017, p. 70) literature study also cites Trumbore (2014) who found that "engagement is necessary for learning and course designers should use strategies for better student engagement both in online and on-campus education". The course design tools were identified in this study as:

1. Peer discussion for collaborative communication (section 5.2.1).
2. Certification (formal or informal) and pathways to further learning (section 5.2.2).
3. Instructor visibility and accessibility (section 5.3.1).
4. Manageable course timeframes (section 5.3.3).
5. Dependable assessment instruments (section 5.5.1).

With the sixth design practice of Effective Course Materials as identified by Gamage et al. (2014) and advocated as a dual content approach to learning by this study. The dual approach is further supported by Paton, Scanlan, et al.'s (2018) research as the inclusion of interactive videos and supplementary PDFs increased engagement especially when the learning materials were reinforced with simple and clear explanations (Hew, 2014). However, some issues were found for learners with slow network speeds and these learners found that their studies were impeded when the videos did not play adequately. By providing the interactive PDFs as an alternative learning resource, the learner could continue with their studies even if it was not their most preferred learning style. Together, these factors suggest the course materials should include a variety of interactive technologies to suit different learning styles with the added advantage it can be used as an alternative learning tool to counteract technology issues.

Bruff et al.'s (2013) research found students had a distinct preference to the way learning materials were released and confirmed by this study. As when the course content was systematically released 5% more learners completed the course when compared to flexible content release of information. This finding is complementary to Perna et al.'s (2014) where learners who started out randomly, generally ended up working systematically through the course. However, as this research found, online courses that have strong and reliable course design structures can improve engagement and learner completions. Therefore, content release issues are slightly diminished when course design is of a high order. Even so, as systematic content release shows higher completions it is suggested online courses should employ this strategy while affording learners the opportunity study in their own time and at their own pace.

In Gamage et al.'s (2014) study, the course materials needed to be relevant, up-to-date, and meet the goals of the learner to encourage retention. This study supports these ideals, as there was a strong relationship between learner success and the learner's perceptions the resources were easy to use and sufficient or enjoyable. This finding further indicates interaction tools that are easy to use and learning materials that supply adequate information transfer can deepen the learners' understanding of the topic which promotes ongoing retention. Additionally, the course materials in the MOOC, as they utilised interactive delivery methods and the user-friendly Canvas platform, these were the preferred design over the learning materials delivered by the eLearn online courses. Furthermore, as the MOOC offered both interactive videos and PDFs, the learner could learn using their preferential learning style and summed up by this student's remark: *"The variable approaches one can take to this course make the experience a very dynamic [sic] and easy to tailor to personal strengths and learning styles as well as fitting in with personal and professional commitments."* This lends itself to a reason for why MOOC students were more positive about the course materials than SPOC learners. It is suspected SPOC learners as they were required to use both Canvas and eLearn, the movement between platforms and the lack of innovative delivery techniques in eLearn could have been a cause for dissatisfaction in this group. However, 95% of students agreed that the course materials made a substantial impact on their learning. Therefore, this study advocates for the course content to be localised on the same educational platform to reduce confusion, dissatisfaction and to better enrich learner retention.

5.5 Research Question 4: What are the relationships between student engagement in VET MOOCs, SPOCs, and online environments?

Research question 4 specifically concentrates on the relationship between learner engagement, the intricacies of assessments and the capacity for the learner to complete the course. As suggested by the literature review by isolating the learning attributes that are most conducive to the learner, engagement can be improved.

5.5.1 Well developed assessment tasks interlaced with course outcomes

Onah, Sinclair, and Boyatt's (2014) research of two programming courses found that the decline across the five quizzes was 22% and 38% and it was confirmed by this study as learner completions across the four weekly quizzes also showed a decline. However, the decline of students in this study was considerably less with only 16% of all learners and 19% of MOOC learners across the four weeks, dropping out. Furthermore, Hew (2014) advises that student engagement can be reduced or even halted after the learner completes their first assessment task and noted in this study, as a larger proportion of students left the course after the first assessment than after any other assessment tasks. Additionally, the learner assessment completion statistics in this study correlates with the findings from Ye and Biswas (2014) in that the number of quiz absences for each learner is proportional to the learners that drop-out over the courses duration.

Another finding of this study was between students who completed the four weekly quizzes and the opposing learning environments. SPOC students completed the weekly quizzes more frequently than MOOC students. This could be a manifestation of the initial enrolment process, where SPOC learners were required to pay fees before they commenced, and this provided a stronger motivation to complete (Impey et al., 2015). Whereas for MOOC students the course was free and they could stop studying at any time without penalty. An important finding observed by DeBoer et al.’s (2013) study was a strong positive relationship between the number of student activities completed and their final assessment totals. This study also found a strong positive relationship between the activities a learner completes and their weekly final assessment score. This indicates that learner completion is proportional to the activities the learner completes.

Jordan’s (2015) investigation preferred multiple choice quizzes aligned to the course curriculum, over peer and teacher marked assessments, to better facilitate engagement. This study quantifies this view as when the assessment pass mark was set to CBT assessment measures (fully competent and gained a 100% pass mark in unlimited attempts for each assessment) 6% more learners completed the course. In comparison to the courses that had a 60% pass mark in two attempts for each assessment. The learners in this study also found the self-marking quizzes added to their learning and it is summed up by this students’ statement: *“I am learning as much from getting answers wrong, so the quiz design is helpful. There is no fear of wrong answers, which means it's easier to engage”.* Jordan (2015) aptly reminds educators to carefully weigh up assessment outcomes and to consider using automated assessment methods, if they meet their educational goals and self-assessments were observed by Admiraal et al. (2015) as having the highest reliability. Consequently, this study endorses their findings as to the integration of CBT assessment strategies through self-marking multiple-choice quizzes to promote ongoing learner engagement. This assessment method was also perceived by learners as manageable and achievable. It should be noted that none of the VET courses evaluated in this study used peer-assessment strategies. However, this would be an interesting direction for future research.

5.5.2 Learners’ capacity to achieve

The learner’s competence on enrolment plays an important role as learners who do not have the underpinning skills and knowledge are disadvantaged from the onset (Evans et al., 2016; Khalil & Ebner, 2014) and this is a factor noted by this study. The MOOC offered in this study did not have any prerequisites. Conversely, the CIT courses and SPOCs did require the learner to have basic computing skills and to be able to demonstrate basic literacy and numeracy skills. Therefore, SPOC and online learners did have an established minimum level of capacity before they enrolled. The SPOC/online students had prerequisite requirements prior to enrolment and these accounted for 24% more SPOC/online students completing their course.

The most significant VET MOOC learner variable detailed from the study was the learner's level of education. Engle et al.'s (2015) study revealed most participants held doctoral degrees and this had a substantial influence on the student's ability to achieve. Additionally, for English as the student's first language, their research observed a significantly lower proportion of students did not complete if English was not their primary language. In this study, only 7% of MOOC participants had PhDs and most learners fell into the category of having completed a 4-year college degree or higher qualification. Additionally, for 56% of VET MOOC learners, English was their primary language. Interestingly, for online/SPOC learners, their highest level of education was High School or College Preparatory School or Master's Degree which confirms the broad representation of learners that frequent VET courses. In further contemplation of the final SEM, the most advantageous learner demographic factors were dedicated study time, self-nominated active learners and learners with prior online course experience, since with these attributes' learners were more likely to complete the course. As learning is the process of acquiring or updating knowledge and skills and the ability of the learner to build capacity through these experiences, a free course could assist the educational organisation to develop skills in learners prior to them enrolling in a full course. The would reduce feelings of inadequacy (Whitmer, Scholrring, James, et al., 2015; Wladis et al., 2014; Yates et al., 2014) as a lack of educational aptitude, poor computer and typing proficiency, or technical issues (Baxter & Haycock, 2014; Safford & Stinton, 2016; Veletsianos et al., 2015) can cause the learner to withdraw. Educational organisations generally enforce the practice of prerequisite validation on course entry. This prevents learners who do not have the capacity to achieve from enrolling and reduces student drop-out. Additionally, Engle et al. (2015) found that learners with a previous background in a specific topic had better course performance and were more likely to complete. As such this study recommends educational organisations initially assist learners to achieve in their online studies by fostering skills and specific topic knowledge through a free online course or MOOC offering skills recognition or a micro-credential, that is linked to a partial or full qualification.

5.6 Research Question 5: How effective is the evolutionary development of a best practice MOOC design in maximising student engagement and retention?

The four key research predictors (Figure 6), assessment structure, sense of community, course content flow, and instructor accessibility revealed several strategies that maximised student engagement and retention in MOOCs and online courses. To summarise, CBT assessments when set to 100% with unlimited attempts, resulted in 11% more students completing, and this suggested that more learners would finish the course when CBT assessment measures were incorporated. An 8% increase was shown in learners who succeeded when optional discussions were instigated but the negative outcome was posting participation declined by 40%. For course content flow, when compared to systematic and flexible content release, the data suggested that systematic release was the most appealing and this improved completions by 7%. The instructor's role was important but the most conducive support an instructor could provide and still maintain strong engagement was an initial welcome post, beginning week summary, weekly article links, and teacher chat in optional content-related discussions. The level i4 instructor support techniques (as described in section 4.8.4.4) were the methods that best demonstrated to the student the instructor was active in the course and always available for required assistance. The increase in completions was also 6% improved when the instructor used these communication techniques. The outcomes from the research predicator analysis have been incorporated into the discussions previously presented in this chapter.

5.6.1 The VOOM Model

The SLR (Systematic Literature Review) engagement and retention tree (Figure 3) has been elevated to a more sophisticated model (the VOOM model) and grounded on the overall findings of this study. Although the study specifically concentrated on VET technological environments, the VOOM model could be applicable to all educational organisations as the best practice attributes are broad enough to suit all forms of technology-rich online learning and illustrated in Figure 26. The VOOM model builds upon the SLR engagement and retention tree by extending each branch with the positive behaviours discovered in this study (green leaves) to enhance student engagement and retention.

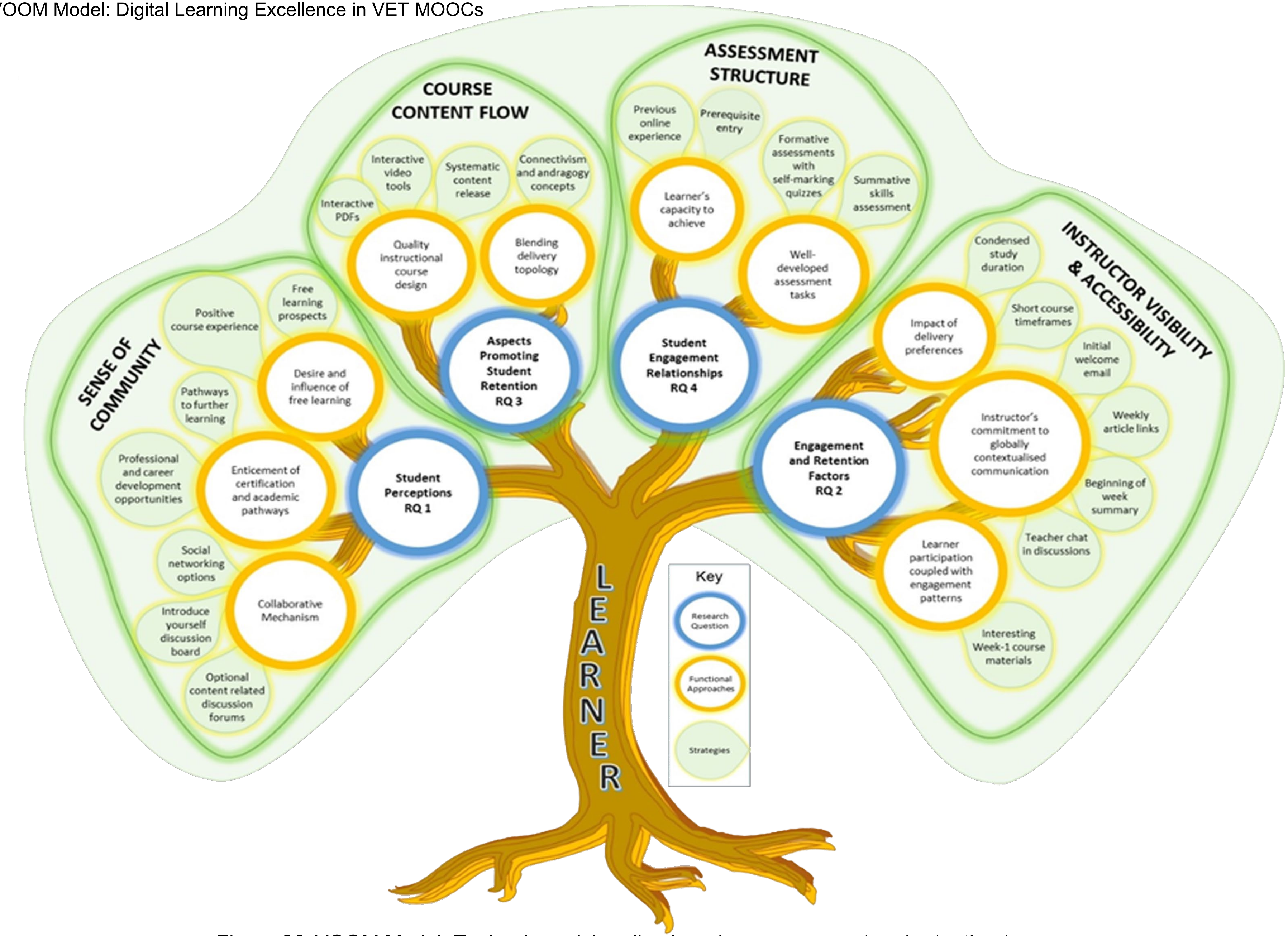


Figure 26. VOOM Model: Technology-rich online learning engagement and retention tree.

The VOOM model specifically focuses on the research questions (blue circles), functional approaches (golden circles) and strategies (green leaves), that most engaged and retained learners' studying through fully online technology-rich learning environments. The key themes and practical application methods will need to be considered and framed for each course, discipline area and to meet organisational requirements but the interconnected relationships between the learner and the VOOM techniques will enhance learner completions. From this study, the inclusion of the VOOM Model was shown to contribute to a 10% increase in student completions. The techniques identified by the VOOM model are briefly explained as follows.

Student perceptions (RQ1) and invoking a *sense of community* can be achieved by incorporating *collaborative mechanisms* such as the 'Introduce Yourself' discussion board and social networking opportunities in the course design. *Optional content-related discussion forums* are beneficial for social students who want to connect with their peers and independent learners who do not wish to socialise. The process of learners writing and reading postings is advantageous for learning. However, so is the commentary that is provided by an international learner-base. Learners are more likely to complete if the course offers the *enticement of certification and academic pathways* to further learning potential. The course must also be focused on giving the learner *professional and career development* capabilities. The *desire for and influence of free learning* increases the number of *prospective learners* and a *positive course experience* improves learner engagement and course enjoyment. A positive course experience for learners' pre-course, was achieved through course flexibility in terms of access to materials at any time independent of time zones, activities that contributed to the construction of learner competence and the learners' perception that they will gain a better understanding of the topic. However post-course, it was a variety of learning stimuli, the belief of enhanced career prospects and the learners' perception that they had gained knowledge and skills for the discipline studied.

The *aspects promoting student retention* (RQ3) are important considerations, with retention influenced by the *quality of the instructional course design* and a flexible *course content flow*. Technology-rich online delivery models that include *interactive PDFs* and *interactive video tools* improve knowledge transference and reinforce practical skills. The *systematic release of content* advantages both the structured type of learner and the more enthusiastic learner who wishes to progress more quickly. The *blending of delivery topologies* by interconnecting *connectivism and andragogy concepts* provided a balanced and educationally sound course structure. A cMOOC design supports the connectivism construct with learning made through social encounters. When this was combined with adult learning principles and e-Learning topologies such as discussion boards and social networking sites, learner collaboration was heightened. Additionally, usable interactive technologies and task-orientated activities that were relevant to the student's job or personal development were also shown to be more conducive in retaining the adult learner.

Student engagement relationships (RQ4) can be combined with the *learner's capacity to achieve* and the *assessment structure,* as improved learner completions are noted when the learner has had *previous online experience*. There was also evidence that *prerequisite entry* will increase the number of learners who finish a course. Assessment tasks, on the other hand, must be perceived as achievable by learners and *well-developed assessment tasks* that include *formative assessments with self-marking quizzes* can tempt learners to continue and further engage with the course. To ensure learner competency is met in self-marked assessments, the learner must achieve 100% in unlimited attempts to comply with CBT assessment measures, where successful completion of all assessment tasks to the required standard is considered competent. The formalisation of learner competency can then be verified through a *summative skills assessment* using the RPL (Recognition of Prior Learning) process and fees charged accordingly.

The favourable factors that promote *learner engagement and retention* (RQ2) recognise that learners have constraints that often impinge on their ability to engage with the course. Better retention can be accomplished when the instructor is viewed as *visible and accessible*. The *impact of delivery preferences* is a paramount consideration as *condensed study duration*

(1–6 hours of study each week) and *short course timeframes* (delivered over 2–6 weeks) will increase the number of students who complete the course. Instructors must be *committed to globally contextualised communication* and this can be achieved with ongoing dedication to communicating in ways that influence student engagement. The four I's of instructor support can be instigated by the teacher, this includes an *initial welcome email, weekly article links, a beginning of week summary,* and *teacher chat in discussions*. *Learner participation coupled with engagement patterns* showed active learners completed the courses more frequently, but the engagement of other learner types can be enhanced with learning tools that are fun and reinforce learning. The first week of any course is the most difficult for any student. The process of absorbing new information and familiarising themselves with the learning tools can be unnerving and withdrawals at this point are more common. A course that has *interesting Week 1 course materials* and manageable learning tasks aids retention as the learner is more likely to continue and engage with the Week 2 materials.

5.7 Summary of Discussion

The VOOM model (Figure 26) was developed as an outcome of the study findings and visually outlines the best strategies for fostering engagement and increasing learner retention in technology-rich online learning courses. The inclusion of the VOOM Model in online courses was found to contribute to a 10% increase in student completions.

6 Conclusions, Recommendations and Future Directions

6.1 Introduction

The MOOC evolution is paving the way for a new wave of educational learner who operates in a globalised context. This is a move away from the traditional models of distance learning to a more interactive blending of technologies and communication tools. The empowerment of MOOC learning is the ability to learn for free, gain knowledge and try out new skills in any area of interest. Therefore, individuals can now explore new and interesting career paths which are free of charge and which would not have been previously possible without the MOOC initiative. The VET sector has been slow to respond to the MOOC revolution (Flexible Learning Advisory Group, 2013) and for new VET MOOCs wishing to enter the marketplace, the only academic literature available is from university MOOC studies. The pathway for VET in the MOOC scene is uniquely different as the VET education system revolves around competency-based learning of practical skills and knowledge for career building and development. This final chapter is an overall summary of the study and it reveals the conclusions, recommendations and directions for future VET MOOC research.

6.2 Conclusions and Recommendations

The aim of this study was to investigate through action research (Figure 1) learner engagement and retention strategies in VET MOOCs, SPOCs, and online delivered courses, to build a best practice VET MOOC model. VET, as a higher education system supports learners to build workplace-specific skills and knowledge. However, academic literature surrounding online VET models is limited and for VET MOOCs practically non-existent. The learning environments for the study focused on three online models:

1. MOOCs through the Biometric Technologies: Identification for the Future course, which was free and available to an international audience on the Canvas platform.
2. SPOCs which used the same course materials as the MOOC, but students enrolled at CIT were able to access CIT facilities, use the eLearn platform in conjunction with Canvas and completed a final summative assessment.
3. For the online units, two were selected from the Certificate IV in Biometric Technologies qualification, these were: FSCBMT401 Principles of Biometric Technologies and FSCBMT403 Apply Forensic Digital Imaging Techniques and delivered through eLearn.

The foundation attributes of the literature findings were combined into the SLR engagement and retention tree (Figure 3) and this formed the basis for the research. The theoretical framework (Figure 4) then provided the conceptual links and methodological practices for the study, while the phase analysis (Figure 5) contributed to the comparison data between learners and across learning groups. As there are no other VET MOOC developments with which to compare this research, this study provides the first glimpse into how VET MOOC learners prefer to learn and what type of individuals are frequenting VET courses. The five research questions were answered by statistically and qualitatively exploring the engagement and retention of 683 learners studying across three different learning environments to determine the attributes and learning processes that best suited these learners.

6.2.1 VET students' perceptions of MOOC learning

The three factors identified from this research and the main components perceived by learners as important when studying a free online VET MOOC were:

- The learner's sense of community through collaborative mechanisms (section 5.2.1)
- Enticement of certification and academic pathways (section 5.2.2)
- Desire and influence of free learning (section 5.2.3)

Recommendation 1: Instructors and course designers should include optional social interactivity tools in the course design to promote social learning communities and stronger engagement.

The learners' sense of community was found to be enhanced when students participated in discussion activities, but it was inconclusive whether social networking sites also assisted with this. The act of posting and reading discussions promoted learner inclusion, with more than half of all VET MOOC and SPOC learners who posted to discussion forums then going on to complete the course. Learner progression was also higher when learners contributed to the discussion activities and over 71% of learners preferred some type of social connection to be incorporated into the course design. Even so, learners did not want social learning as the only form of interaction, but their preference was for a variety of support options which included instructor, peers and social networking tools.

Recommendation 2: Educational institutions should issue a statement on MOOC completion and offer skills recognition and pathways to further aid learner retention.

Certification was an important factor for 17% of MOOC learners as it enhanced their career opportunities. The award provided the initial motivation for students to enrol and then offered an ongoing incentive for them to complete. The advantages learners perceived from gaining MOOC certification was as proof of professional development, the option to be formally acknowledged for their studies, and an opportunity for ongoing study. In competency-based models, the micro-credential application of the MOOC certificate in combination with RPL assessment tools can be used to validate the learner's practical application before the offer of additional study pathways into other nationally recognised qualifications are offered by the VET institution.

Recommendation 3: Educational institutions and course designers should ensure the course structure is professionally focused with visible job possibilities to stimulate engagement.

The desire to enrol and complete a VET MOOC for 42% of pre-course learners was the ability to enhance professional development skills and 55% believed it would be the learning experience that would assist them to progress. However, post-course 62% of learners wanted to have an improved knowledge of the topic and this was achieved through a positive learning experience. Inherently, the course should incorporate visible and tangible work outcomes aligned with real jobs to enhance the student's career development prospects. Additionally, the overall course rating and recommendations by learners were strong indicators that students enjoyed the learning experience and there was a higher likelihood that they were retained and completed the entire course.

6.2.2 The factors identified in student engagement and retention for VET MOOCs

The study identified three main factors that promoted learner engagement and improved retention, these were:

- Instructor's commitment to globally contextualised communication (section 5.3.1)
- Learner participation coupled with engagement patterns (section 5.3.2)
- Impact of delivery preferences on engagement and retention (section 5.3.3)

Recommendation 4: Instructors should be visible and accessible for ongoing learner engagement and this can be achieved through an initial welcome post to the student, providing a weekly summary, a weekly link to recent information, and participation in optional content-related discussion groups.

The instructor was an integral component of the course and necessary for strengthening learner progression. Learners required a range of communication tools and a variety of involvement sources to help them interact with peers and the instructor. Therefore, by providing learners with general discussion boards that allow the learner to introduce themselves to others, gain specialised assistance for the course or advice for technical concerns can reduce unnecessary postings to optional content-related forums. General forums were also found to be useful for learners who do not want to socialise, as for them it was the learning process they identify as the most important aspect of the course. The most frequented discussion board in this study was Introduce Yourself and the high posting rate shows willingness for learners to start a communication flow quite early in the course. As the teacher is the co-constructor for learning, ensuring their visibility was also important for improved learner retention. This was achieved by providing regular updates to learners to remind them that the instructor was a real person, which kept the lines of communication more clearly open between learner and instructor. The most effective instructor support strategies that promoted learners to engage without them feeling harassed or overloaded, was when the instructor provided an initial welcome post, sent weekly article links, announced a beginning of week summary and, on occasions, participated in the chat on the content-related discussion boards. These strategies were representative of a 7% increase in completions and 8% increase in student success.

Recommendation 5: Course designers should incorporate effective and interesting learning materials into Week 1 of the course to reduce early learner withdrawals and promote ongoing engagement.

Over 71% of learners knew their learner classification type even before they commenced the course. With approximately 1 in 2 active participants and ¾ of observers able to identify their correct classification on enrolment and 90% of the time, passive and drop-in participants could accurately identify their classifications as well. Activity completion was 69% higher in learners who completed the course. Therefore, understanding the learner's type is an important aspect when determining engagement patterns as individuals will use the course information to meet their own personal needs and, in some instances, this does not include finishing course tasks. The four significant points in the course where learner activity reduced were after the very first topic page in Week 1 where a large withdrawal was noted, the first activity in Week 1 showed a smaller but still significant drop-out, and then again after the Week 1 discussion activity. Finally, after the Week 3 topic page another small drop-out was noted. This indicates that drop-out is a natural outcome of a MOOC but learners who completed the first topic of Week 1, Week 3, and Week 4 were over 19 times more likely to finish the course than learners who did not complete that activity.

Recommendation 6: Instructors and course designers should provide interactive tasks to maintain learner interest and to enhance skills and knowledge for impending assessments for better retention of learners.

Learner engagement was 13% more predicative of course achievement than retention and was found to be reliant on the following factors:

- Learner's course rating improved retention and engagement when a high rating was bestowed for the overall course and course recommendations.
- Learner's participation strengthened engagement when interactive content was enjoyable, beneficial for learning and easy to use.
- Learner's demographics increased retention when the learner dedicated course study time, was self-assessed as an active learner and had previously studied an online course.

Hence, providing good quality content that is delivered in an innovative and interesting way was conducive to learner engagement and reinforced the retention of information. This was equally matched by the perceptions of the learners that the course was interesting, achievable, and could be completed within a relatively short timeframe. However, the educational undertone of the course needed to have reasonable assessment expectations and offer alternative study pathways. The inclusion of these attributes provided the student with a quality learning experience which promoted stronger engagement and retention.

Recommendation 7: Educational institutions and course designers should construct courses with condensed study duration and short course timeframes that are equivalent to the publicised hours to better improve learner retention.

The number of hours a student perceives they will spend on their study's pre-course is consistent with the time they do spend completing their studies. Therefore, when learners allocate time set around the recommended course hours and if the total course length is manageable, learners are more likely to successfully finish the course. However, the range of days to complete the MOOC was between 1 day and 55 days with the average being 15 days. This is significant as most learners were completing the course well before the 28 days allocated. This outcome requires learning organisations to decide on the possibility of reducing the course duration as learners are completing the course on average 54% quicker or even to extend the course length by an additional 50% as this could improve completions by 14%. However, such an extension would depend on the learning organisation's support in terms of higher teacher costs, time and resources to attain the extra 14% increase in learner completions.

6.2.3 The relationships between student retention in VET MOOC, SPOC, and online environments

The most important factor found for learner retention in MOOCs and online courses were the quality of the instructional course design and its relationship to its underpinning framework (section 5.4.1). A MOOC needs to blend the learning topology which is most suited to the discipline, with the learning delivery platform and the learning institution's requirements. The influential design principles were collaborative communication, instructor visibility, and manageable timeframes but effective course materials also played a critical role in learner engagement in this study. However, the course rating score and the learner's course enjoyment through recommendations were other important indicators of retention, with over 98% of learners' post-course giving them the highest rating.

Recommendation 8: Course designers should include a variety of interactive technologies designed to suit diverse learning styles to better retain learners.

The sufficiency and variety of resources were also highly valued among learners and this was an outcome of the course materials utilising a variety of interactive delivery methods, with 92% of MOOC and SPOC learners perceiving the video interactive technologies were easy to use and for 87% they made a substantial impact on their learning. Offering both interactive videos and PDFs meant learners could learn using their preferential learning style. Learners who chose to read over watch/listen or vice versa had the correct learning tool to gain the knowledge and practical skills in the first instance. The other tool was then used for reinforcement and practice.

Recommendation 9: Instructors and course designers should employ systematic content release, but the course structure must still allow the learner to study in their own time and at their own pace to improve learner retention.

The course content flow between systematic and flexible content release of information revealed a 6% increase in learners who completed and 7% of learners who successfully completed when the systematic content release was instigated. This outcome was a surprise as a flexible course release model was presumed to be more suited to a fully online technology-rich learner. However, as this research found, a course that has strong learning structures and reliable course designs can improve engagement, which in turn leads to better learner completions.

Recommendation 10: Educational institutions should locate content on the same online educational platform to enrich retention and to reduce learner confusion or dissatisfaction.

SPOC learners gave a lower ranking (8 out of 10 highest) for the course rating as the movement between platforms and the lack of innovative delivery techniques caused dissatisfaction. This is an important aspect to consider when offering MOOCs that do not reside on the organisation's electronic learning management system. However, for VET MOOCs, the organisation's internal information technology infrastructures are often not designed to contend with the constant learner movement and numbers that MOOCs attract.

6.2.4 The relationships between student engagement in VET MOOC, SPOC, and online environments

The final attribute of a well-designed online course and for improved student engagement is the quality of the assessment instruments and the best strategies to deliver competency-based skills tests that are valid, sufficient, and authentic. Assessments often cause fear and anguish; therefore, if a learner perceives they have the capacity to complete them, this improves engagement and ongoing progression. This research identified two factors that strengthened learner engagement:

- Well-developed assessment tasks interlaced with course outcomes (section 5.5.1)
- Learner's capacity to achieve (section 5.5.2)

Recommendation 11: Instructors and course designers should integrate competency-based assessments including 100% pass mark and unlimited attempts as these are perceived by the learner as manageable, achievable and encourage ongoing engagement.

There was a difference of 24% in the number of MOOC learners who completed when compared to learners who enrolled in the institution-based courses. The average MOOC learner completed 53% of the time when compared to institutional learners who completed 77% of the time. The higher completions in the institutional learners were reflected by the initial enrolment process and the requirement to pay fees before the learner commenced their course. These factors provided learners with extra motivation to forge through and finish. In consideration of the 53% completion statistic for VET MOOCs, this was quite improved compared to the previous study by Paton, Scanlan, et al. (2018) where 35% of MOOC learners completed and considerably improved compared to universities which have been cited as between 12% and 36% (Dillahunt et al., 2014; Jordan, 2014; Perna et al., 2014).

The point for all learners in the course that represented the strongest predictor that the learner would finish was at the Week 3 quiz mark which was ¾ of the way through the course and at this point most learners were quite motivated to complete. There was also a strong relationship among the amount of activity undertaken and the learner’s final assessment score. This was implicit of the more activities a learner accomplishes the more likely they are to complete. Conversely, there was a 16% decline in learner participation across the four weeks and this was proportional to the number of students who dropped out after each quiz absence.

Recommendation 12: Educational institutions should provide free technology-rich online learning, which is partially or fully aligned to an accredited course, to build online learner confidence prior to qualification enrolment and to enrich engagement and retention.

The learner’s capacity to achieve can be impeded or enhanced through the enforced practice of prerequisite entry. A 24% increase in completions was the outcome for online and SPOC learners when compared to the MOOC learner group. It was surmised that this significance was a reflection of the minimum entry requirements in these groups. However, the demographic attributes of learners entering technology-rich online courses also had a strong impact on the learners’ abilities to achieve. There was improved learner engagement when the student had the following attributes:

- The highest level of education was a master’s degree or equivalent.
- English was their primary language.
- The learner's place of residence was primarily in Australia or America.
- The learner was male.
- They had previously studied a course on the Canvas Network or with another educational provider.
- They had previous online study experience.

The learner attributes modelled in this study found that 13% of learner demographic factors affected retention. The most advantageous was 86% for individuals who had devoted dedicated time to their studies, 68% for self-nominated active learners and 58% for learners who had studied a prior online course. VET learners who dedicated time and actively participated in learning tasks were retained longer and were 60% more likely to complete the course. It is complex if not impossible for an educational provider to ensure students are dedicated to their studies and will actively participate. However, as prior online experience also affects learner engagement and retention, this attribute could be initially fostered through a free online course or MOOC offering micro-credentials that are linked to a qualification. A course such as this optimises the student's learning proficiency as it provides an online learner preparation tool in the first instance, then a mechanism to enhance subject knowledge before the learner pursues further studies, and finally an avenue where the learning is recognised as credits are offered into formal qualifications.

6.2.5 Summary of recommendations

The 12 recommendations outlined in this chapter are key considerations for promoting engagement and enhancing retention in fully online technology-rich learning courses and established on the VOOM model (Figure 26). The recommendations are particularly pertinent to VET providers but additionally suitable for any educational organisation that uses technology-rich online delivery. The final discussion that comes out of these recommendations is the consideration as to whether the process of learner engagement and retention is consecutive or concurrent. It would appear from this research, and the examination of the empirical literature, that they are indeed symbiotic and each one relies on the other in order to achieve successful learner completions, although engagement did have a slightly stronger effect on learner success. From this research, the definition that Gorky (2014, p. 18) proposed specifically for student retention, namely "student judgement of success in studies completed", and the learners' "ongoing recommendations to others", should also incorporate engagement into its syntax and a measure for determining judgement. Therefore, engagement and retention are reconsidered as: *The learners' judgement of success through improved knowledge and skills, and their ongoing recommendations to others.* The progression towards learner success is a combination of structures that support peer interactions to develop a sense of community, an instructional course design that is technologically innovative, assessments which are realistic and achievable, and an instructor who maintains their accessibility and visibility with timely communications.

6.3 Limitations

The transferability of the findings from university MOOCs and VET online courses and the generalisability from the Australian to the global context into VET MOOCs could be problematic for all three learning modes. Additionally, the units modelled in this study concentrated on Biometric Technology proficiencies, which means this topic had unique nuances that could lead to none of the suggested methods being suitable. Furthermore, with diverse learners and learning platforms, it is unknown if the learning tools and strategies ascertained by this study would produce the same outcome in other free educational online delivery models.

Another limitation was the timeframe for the SLR, as 3.5 years could be considered rather narrow. The search boundary was selected as existing systematic literature reviews had already provided extensive coverage of engagement and retention in university MOOCs from 2008 to 2013 (see for example Jacoby, 2014; Khalil & Ebner, 2014).

The quantitative and qualitative research components had restrictions as the participant survey tools were pre-designed by the learning organisations and the outcomes were dictated by the research questions, students' responses, and the survey instruments. The research questions were a limit to a post-positivism research study as inferred statistics only detail a single reality (Golafshani, 2003). Additionally, the participants' responses were constrained to pre-designed options and question selections that were aligned to Canvas and CIT organisational requirements and not specifically developed for this research.

Investigator bias existed as the researcher had long-term involvement in the development and delivery of the courses evaluated for this study and prejudice could be an unconscious result (Creswell, 2014). The researcher also acknowledged that features of connectivism theory exist to some degree in most VET courses (Baxter & Jack, 2008).

The replication of the action research component has inadequacies as the results are specific to the participants and the setting in which the research was conducted (Hine, 2013). Even though the researcher reduced their bias by having an open mind and giving thorough considerations to research theories when interpreting data (Patton, 2002), there are still inherent limitations that may have impacted or influenced those interpretations.

6.4 Future directions

The limitations of this study provide opportunities for future research to be conducted. The directions that were discussed in section 2.14 were explored in-depth by this study. As this is just the first study for VET MOOCs, there needs to be supplementary research on the engagement and retention strategies for VET as they move further into this educational domain.

As this study is only focused on one country, Australia, one organisation, CIT, and one discipline of study, Biometric Technologies for identification and access control, broadening out the research into one of the many other areas that VET presides over would certainly be beneficial for VET's academic andragogy.

Further research into learner self-classification choices and how they relate to the learner's activity progression throughout their studies and their overall completions is suggested. This study identified a strong connection between these factors, however, an examination could be conducted on a larger student cohort and under different course conditions to substantiate these finding.

There is still uncertainty if public social networking sites such as Facebook and Twitter are adding any benefit to learner engagement and retention. Future research might examine how to obtain suitable metrics and how to gauge the benefits as important issues to explore.

Peer-assessment strategies were not evaluated in this study. However, for VET, the ability to provide rubrics that align to the UoC outcomes is quite an easy undertaking and further research into this assessment tool may provide benefit to VET online courses and MOOCs.

Another future direction is a study to further evaluate the attributes of the VOOM Model: Technology-rich online learning engagement and retention tree (Figure 26) through action research modelling of other VET discipline courses.

Although this research followed MOOC, SPOC, and online learners for three years, there is a need for a more detailed longitudinal research study to be conducted on VET MOOC learners.

6.5 Thesis summary

This research investigated MOOCs, SPOCs, and online VET learners, over circular iterations, to develop a framework that would support future VET organisations to attain digital learning excellence in their fully online technology-rich courses. The aim was to broaden academic understanding of how VET learners are engaged and retained by evaluating the aspects that promoted learning.

Compared to situations where the learner was taught by a teacher with a group of students in a classroom, this study has shown there is a need to improve learner engagement and retention in technology-based courses. As the globalisation of work opportunities expand, the learning needs of individuals are changing. This requires educational institutions to engage in these technologies so that learning is more accessible and to enable them to successfully compete with the growing number of educational providers delivering through this mode. The benefits of technology-rich online delivery are the reduction in capital expenditure on physical infrastructure as fewer in-house technologies need to be resourced. Less training time is needed as teachers are becoming more tech-savvy. There is an increased level of industry responsiveness with just-in-time learning and equitable education for all. These aspects reduce some of the financial pressures with which learning organisations contend, particularly as funding becomes more difficult to obtain. However, a strong commitment to quality information technology architecture is imperative for the ongoing success of these models. The learner also benefits as learning over the internet reduces transit costs, travel time and it gives them access to an international base of peers.

The outcomes of this study were the VOOM model and 12 recommendations. The VOOM model provides a conceptual framework for the factors most conducive to fully online technology-rich learning. The recommendations respond to the literature and the findings of this study to provide guidance for institutions, course designers and instructors on enhancing learner engagement and retention. The recommendations are intended for practical implementation with five for instructors, eight for course designers and five for educational institutions. Some of the recommendations require multiple parties to be involved in the deliberations. The scope of the findings primarily extends to VET organisations but generalisability as a practical instruction model is applicable for private education providers, government training programs, vocational community colleges, and corporate training initiatives. Although universities could glean some meaningful insights for inclusion into their own educational practices. These best-practice guidelines reach beyond Australian shores as sustainable learner engagement and retention practices are crucial for global education in a technologically advancing world. Therefore, the implementation of this method advocates happier learners who are more willing to engage with the teaching materials, complete the learning requirements and successfully finish the course.

The National Centre for Vocational Education Research (NCVER) is the Australian professional body responsible for overseeing research and statistics on VET in Australia. The Centre's analysis of 2016 Australian VET data suggests a completion rate of 43% for all Australian TAFE and other government providers (NCVER, 2018). The total expenditure of VET activity in 2016 was $6728 million measured from state and territory operating expenses. Of this total, $6048 million was attributable to student per capita costs with an outlay of $3447 million attributable to students who did not complete. Another economic consequence of learner non-completion is the 2016 VET student loan scheme (VET FEE-HELP) where over $319 million in loans were taken out by students studying with government VET providers (NCVER, 2017). Non-completers would, therefore, have secured $182 million in future debt but had no qualification to show for it.

Educational institutions are continually striving to attain better completion rates at reduced costs. The VOOM model and recommendations have the potential to increase completions by 10%. When this is considered in respect to the NCVER 2016 statistics, a 10% increase from 43% to 53% in the number of students completing their VET courses would be worth $605 million to the economy. Additionally, there is an economic benefit to students as $32 million of VET FEE-HELP debts would be helping students to achieve a qualification. This further enriches Australia’s economy as more highly qualified professionals generally gain higher incomes and repay loans faster. This is very exciting, not just for VET, but also for education globally. Together, the VOOM model and the recommendations provide a catalyst for reimagining techniques that enhance the student learning experience. With these best practice interchangeable strategies, all forms of technology-rich online environments can relish in improved learner engagement and elevated student numbers on course completion.

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APPENDICES

Appendix A: Studies included in the systematic literature review.

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Appendix B: Research Predictors for MOOC and SPOC iterations.

Course iteration	Start date	End date	Factors disguising research predictors				Possible consequences of predictors	Risk of drop-out
			1 Assessment	**2 Sense of community**	**3 Course Content flow**	**4 Instructor accessibility ^**		
MOOC 1 *(control group)*	14/09/15	12/10/15	Complete 4 assessment tasks >60% 2 attempts only	Must contribute to 4 discussion boards	Systematic	Initial welcome announcement	1. Reduced learner motivation if <60 is achieved in both attempts 2. Higher sense of community 3. More structured course flow suitable for less motivated learners 4. Low instructor accessibility	1. High 2. Medium 3. Low (low motivated learners) and Medium (high motivated learners) 4. Medium
MOOC 2	06/11/15	14/12/15	Complete 4 assessment tasks >60% 2 attempts only	Must contribute to 4 discussion boards	Systematic	Initial welcome announcement; fortnightly links to articles	1. Reduced learner motivation if <60 is achieved in both attempts 2. Higher sense of community 3. More structured course flow suitable for less motivated learners 4. Low instructor accessibility	1. High 2. Medium 3. Low (low motivated learners) and Medium (high motivated learners) 4. Medium
MOOC 3	07/03/16	20/04/16	Complete 4 assessment tasks >60% 2 attempts only	Must contribute to 4 discussion boards include general discussion board for personal chat	Flexible	Initial welcome announcement; weekly links to articles	1. Reduced learner motivation if <60 is achieved in both attempts 2. Higher sense of community 3. Flexible structured course flow suitable for higher motivated learners 4. Increased instructor accessibility	1. High 2. Low 3. Medium (low motivated learners) and Low (high motivated learners) 4. Medium

Course iteration	Start date	End date	Factors disguising research predictors				Possible consequences of predictors	Risk of drop-out
			1 Assessment	2 Sense of community	3 Course content flow	4 Instructor accessibility ^		
MOOC 4	16/05/16	13/06/16	Complete 4 assessment tasks >60% 2 attempts only	Must contribute to 4 discussion boards include general discussion board for personal chat	Flexible	Initial welcome announcement; weekly links to articles	1. Reduced learner motivation if <60 is achieved in both attempts 2. Higher sense of community 3. Flexible structured course flow suitable for higher motivated learners 4. Increased instructor accessibility	1. High 2. Low 3. Medium (low motivated learners) and Low (high motivated learners) 4. Medium
MOOC 5	22/08/16	19/09/16	Complete 4 assessment tasks >60% 2 attempts only	Optional contribution to 4 discussion boards include general discussion board for personal chat	Systematic	Initial welcome announcement; weekly links to articles; beginning of week summary	1. Reduced learner motivation if <60 is achieved in both attempts 2. Lower sense of community contribution 3. More structured course flow suitable for less motivated learners 4. Increased instructor passion	1. High 2. Medium 3. Low (low motivated learners) and Medium (high motivated learners) 4. Low
MOOC 6	31/10/16	28/11/16	Complete 4 assessment tasks >60% 2 attempts only	Optional contribution to 4 discussion boards include general discussion board for personal chat	Flexible	Initial welcome announcement; weekly links to articles; beginning of week summary	1. Reduced learner motivation if <60 is achieved in both attempts 2. Lower sense of community contribution 3. Flexible structured course flow suitable for higher motivated learners 4. Increased instructor passion	1. High 2. Medium 3. Medium (low motivated learners) and Low (high motivated learners) 4. Low

Course iteration	Start date	End date	Factors disguising research predictors				Possible consequences of predictors	Risk of drop-out
			1 Assessment	2 Sense of community	3 Course content flow	4 Instructor accessibility ^		
MOOC 7	14/02/17	13/03/17	Complete 4 assessment tasks =100% unlimited attempts	Must contribute to 4 discussion boards include general discussion board for personal chat	Systematic	Initial welcome announcement; weekly links to articles; beginning of week summary; increased chat on weekly discussions	1. Increased learner motivation with no chance of failure 2. Higher sense of community 3. More structured course flow suitable for less motivated learners 4. Increased instructor accessibility & passion	1. Medium 2. Low 3. Low (low motivated learners) and Medium (high motivated learners) 4. Low
MOOC 8	17/05/17	14/06/17	Complete 4 assessment tasks =100% unlimited attempts	Must contribute to 4 discussion boards include general discussion board for personal chat	Flexible	Initial welcome announcement; weekly links to articles; beginning of week summary; increased chat on weekly discussions	1. Increased learner motivation with no chance of failure 2. Higher sense of community 3. Flexible structured course flow suitable for higher motivated learners 4. Increased instructor accessibility & passion	1. Medium 2. Low 3. Medium (low motivated learners) and Low (high motivated learners) 4. Low
MOOC 9	23/08/17	20/09/17	Complete 4 assessment tasks =100% unlimited attempts	Optional contribution to 4 discussion boards include general discussion board for personal chat	Systematic	Initial welcome announcement; weekly links to articles; beginning of week summary; increased chat on weekly discussions; increased email motivation	1. Increased learner motivation with no chance of failure 2. Lower sense of community contribution 3. More structured course flow suitable for less motivated learners 4. Increased instructor accessibility & passion	1. Medium 2. Medium 3. Low (low motivated learners) and Medium (high motivated learners) 4. Low

Course iteration	Start date	End date	Factors disguising research predictors				Possible consequences of predictors	Risk of drop-out
			1 Assessment	2 Sense of community	3 Course content flow	4 Instructor accessibility ^		
MOOC 10	31/10/17	28/11/17	Complete 4 assessment tasks =100% unlimited attempts	Optional contribution to 4 discussion boards include general discussion board for personal chat	Flexible	Initial welcome announcement; weekly links to articles; beginning of week summary; increased chat on weekly discussions; increased email motivation	1. Increased learner motivation with no chance of failure 2. Lower sense of community contribution 3. Flexible structured course flow suitable for higher motivated learners 4. Increased instructor accessibility & passion	1. Medium 2. Medium 3. Medium (low motivated learners) and Low (high motivated learners) 4. Low
MOOC 11	23/01/18	11/06/18	Most significant factors based on evaluation of all iterations	Most significant factors based on evaluation of all above iterations	Most significant factors based on evaluation of all iterations	Most significant factors based on evaluation of all iterations		

Course iteration	Start date	End date	Factors disguising research predictors				Possible consequences of predictors	Risk of drop-out
			1 Assessment	2 Sense of community	3 Course content flow	4 Instructor accessibility ^		
SPOC 1	27/07/15	30/08/15	Complete 4 assessment tasks >60%	Must contribute to 4 discussion boards	Systematic	Initial welcome announcement; fortnightly links to articles	1. Reduced learner motivation if <60 is achieved in both attempts 2. Higher sense of community 3. More structured course flow suitable for less motivated learners 4. Low instructor accessibility	1. High 2. Medium 3. Low (low motivated learners) and Medium (high motivated learners) 4. Medium
SPOC 2	15/02/16	20/03/16	Complete 4 assessment tasks >60%	Must contribute to 4 discussion boards include general discussion board for personal chat	Flexible	Initial welcome announcement; weekly links to articles	1. Reduced learner motivation if <60 is achieved in both attempts 2. Higher sense of community 3. Flexible structured course flow suitable for higher motivated learners 4. Increased instructor accessibility	1. High 2. Low 3. Medium (low motivated learners) and Low (high motivated learners) 4. Medium
SPOC 3	25/07/16	28/08/16	Complete 4 assessment tasks >60% 2 attempts only	Optional contribution to 4 discussion boards include general discussion board for personal chat	Systematic	Initial welcome announcement; weekly links to articles; beginning of week summary	1. Reduced learner motivation if <60 is achieved in both attempts 2. Lower sense of community contribution 3. More structured course flow suitable for less motivated learners 4. Increased instructor accessibility	1. High 2. Medium 3. Low (low motivated learners) and Medium (high motivated learners) 4. Medium

Course iteration	Start date	End date	Factors disguising research predictors				Possible consequences of predictors	Risk of drop-out
			1 Assessment	2 Sense of community	3 Course content flow	4 Instructor accessibility ^		
SPOC 4	13/02/17	19/03/17	Complete 4 assessment tasks =100% unlimited attempts	Must contribute to 4 discussion boards include general discussion board for personal chat	Flexible	Initial welcome announcement; weekly links to articles; beginning of week summary; increased chat on weekly discussions	1. Increased learner motivation with no chance of failure 2. Higher sense of community 3. Flexible structured course flow suitable for higher motivated learners 4. Increased instructor accessibility & passion	1. Medium 2. Low 3. Medium (low motivated learners) and Low (high motivated learners) 4. Low
SPOC 5	26/07/17	29/08/17	Complete 4 assessment tasks =100% unlimited attempts	Optional contribution to 4 discussion boards include general discussion board for personal chat	Systematic	Initial welcome announcement; weekly links to articles; beginning of week summary; increased chat on weekly discussions; increased email motivation	1. Increased learner motivation with no chance of failure 2. Higher sense of community 3. More structured course flow suitable for less motivated learners 4. Increased instructor accessibility & passion	1. Medium 2. Medium 3. Low (low motivated learners) and Medium (high motivated learners) 4. Low
SPOC 6	12/02/18	18/03/18	Most significant factors based on evaluation of all iterations	Most significant factors based on evaluation of all iterations	Most significant factors based on evaluation of all iterations	Most significant factors based on evaluation of above iterations		

APPENDIX C: STUDY INFORMATION AND CONSENT FORM.

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Information Sheet

Designing and Evaluating MOOC (Massive Open Online Course) effectiveness within the area of Biometric Technologies, in the discipline of Forensic Science.

This information sheet is for students participating in the Biometric Technologies: Identification for the Future MOOC which is offered by the Canberra Institute of Technology, Australia, Canberra.

1. Invitation

You are invited to take part in a research study that examines student retention and engagement in Vocational Educational and Training (VET) Small Private Online Courses and online learning environments will be compared to students who are studying in a MOOC delivery mode.

2. What is the purpose of this study

This research aims to advance knowledge into student capabilities and learning receptiveness against each learning mode, and the evolutionary journey of a MOOC delivery model. Specifically this research will examine the following questions.

1. What are Vocational Education and Training (VET) students' perceptions of MOOC learning?
2. What are the factors identified in student engagement and retention for VET MOOCs?
3. What are the relationships between student retention in VET MOOC, SPOC and online environments?
4. What are the relationships between student engagement in VET MOOC, SPOC and online environments?
5. How effective is the evolutionary development of a best practice MOOC design in maximising student engagement and retention?

3. Why have I been invited to participate?

You have been invited to participate as you are currently enrolled as a student in this course. As this project focuses on the student learning and course progression, your participation in this study is of considerable value.

Your involvement is voluntary. There are no consequences if you decide not to participate. Having said this, we are hoping for as high a response rate as possible to enable a full picture to be secured of student retention rates, learner perceptions and MOOC effectiveness.

4. What will I be asked to do?

There are no specific requirements, just complete the course as you wish.

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5. Are there any possible benefits from participation in this study?

While there are no intended benefits for participants in this study, the likelihood that a better understanding of delivery approaches that maximise student retention and encourage sustainable lifelong learning will be identified and reflected in VET teaching practices.

6. Are there any possible risks from participation in this study?

We do not foresee any risks from participation in this study, but please let us know if you have any concerns.

7. What if I change my mind during or after the study?

You are free to withdraw your consent to participate at any time, and can do so without providing an explanation.

If you choose to withdraw from this study, I will ask your permission to retain any data that has been collected so far. You are free to decline this request. Data that has already been processed will not be able to be withdrawn.

8. When this study is over?

The data from this study that is kept will not bear participants' names or be identifiable after the completion of the project. In accordance with the research requirements, research data will be kept for 5 years from the date of completion of the study. All data relevant to your participation will be destroyed. Specifically electronic files will be deleted from computer hard-drives and servers, and electronic "rubbish bins" emptied and paper documents will be securely shredded.

9. How will the results of the study be published?

This study forms a part of the requirements for a Doctorate and, as such, findings will be presented at a number of forums for educational research. The dissertation may or may not be published. No participant will be identifiable in the final report.

10. How will my confidentiality and anonymity be maintained?

The researchers will assign research identifiers to the data obtained from surveys and course analytics. Any researcher that is instructing on the course and has prior access to the data will ensure they do not gain access any information before the assessment results are released at the end of the course.

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11. What if I have questions about this study?

Our contact details are:

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"This study has been approved by the Tasmanian Social Sciences Human Research Ethics Committee. If you have concerns or complaints about the conduct of this study, please contact the Executive Officer of the HREC (Tasmania) Network on (03) 6226 7479 or email human.ethics@utas.edu.au. The Executive Officer is the person nominated to receive complaints from research participants. Please quote ethics reference number [H0015193]"

This information sheet is for you to keep.

You will need to provide your consent to be involved. You will be asked for your consent in the **Research Study Participation Consent Quiz.**

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Appendix D: Welcome to Canvas Network Survey including participation consent request.

Question 1 — 0 pts

Research Study Participation Consent

Research Study:Designing and Evaluating MOOC (Massive Open Online Course) effectiveness within the area of Biometric Technologies, in the discipline of Forensic Science.

1. I agree to take part in the research study named above.

2. I have read and understood the Information Sheet for this study.

3. I understand that the study involves no specific requirements on my part.

4. I understand that participation involves no foreseeable risk(s).

5. I understand that all research data will be securely stored for five (5) years from the publication of the study results, and will then be securely destroyed.

6. I understand that the researcher(s) will maintain confidentiality and that any information I supply to the researcher(s) will be used only for the purposes of the research.

7. I understand that the results of the study will be published so that I cannot be identified as a participant.

8. I understand that my participation is voluntary and that I may withdraw at any time without any effect.

- ○ Yes I agree to participate in the research study
- ○ No I wish to decline my participation

Question 2 — 1 pts

What is your primary reason for taking an open online course?

- ○ I like the format (online)
- ○ I enjoy learning about topics that interest me
- ○ I enjoy being part of a community of learners
- ○ I hope to gain skills for a new career
- ○ I hope to gain skills for a promotion at work
- ○ I am preparing to go back to school
- ○ I am preparing for college for the first time
- ○ I am curious about MOOCs
- ○ I want to try Canvas Network

Question 3 — 1 pts

Not everyone has the same participation and learning goals. We welcome the diversity.

Which type of online learner best describes you?

- An observer. I just want to check the course out. Count on me to "surf" the content, discussions, and videos but don't count on me to take any form of assessment.
- A drop-in. I am looking to learn more about a specific topic within the course. Once I find it and learn it I will consider myself done with the course.
- A passive participant. I plan on completing the course but on my own schedule and without having to engage with other students or assignments.
- An active participant. Bring it on. If its in the course, I plan on doing it.

Question 4 — 1 pts

How many hours a week are you planning to spend on this course?

- Less than 1 hour
- Between 1 and 2 hours
- Between 2 and 4 hours
- Between 4 and 6 hours
- Between 6 and 8 hours
- More than 8 hours per week

Question 5 — 1 pts

How will this course help you meet your personal or professional goals?

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Question 6 1 pts

What is your highest level of education?

- High School or College Preparatory School
- Some college, but have not finished a degree
- Completed 2-year college degree
- Completed 4-year college degree
- Some graduate school
- Master's Degree (or equivalent)
- Ph.D., J.D., or M.D. (or equivalent)
- None of these

Question 7 1 pts

Is English your primary spoken language?

- Yes
- No

Question 8 1 pts

Where do you live?

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- North America
- Central America
- South America
- Caribbean
- Western Europe
- Eastern Europe
- Africa
- Middle East
- South Asia
- East Asia
- Southeast Asia
- Russia
- Australia & South Pacific

Question 9 1 pts

What is your gender?

- ○ Male
- ○ Female
- ○ Other

Question 10 1 pts

How old are you?

- ○ 13-18
- ○ 19-24
- ○ 25-34
- ○ 35-44
- ○ 45-54
- ○ 55-64
- ○ 65 or older

Question 11 1 pts

How did you hear about this Canvas Network Course? (select all that apply)

- ☐ Through a social media site (like Facebook or Twitter)
- ☐ From a news story (print, online, radio, or TV) that mentioned Canvas Network
- ☐ From a friend or colleague
- ☐ I clicked on an ad
- ☐ From a web search
- ☐ From the instructor
- ☐ From a Canvas or Canvas Network communication

Question 12 1 pts

Where have you taken an online course before? (Select all that may apply)

- ☐ Never taken an online course
- ☐ At school
- ☐ Canvas Network
- ☐ Coursera
- ☐ EdX
- ☐ Udacity
- ☐ Other

Question 13 1 pts

If you have any general feedback you'd like to provide, please do so here:

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Appendix E: Canvas Network: The User Experience Survey.

Question 1 1 pts

How strongly do you agree or disagree with the following statement:

The course materials (lectures, videos, documents) have a positive impact on my learning experience.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Question 2 1 pts

How strongly do you agree or disagree with the following statement:

The course activities (discussions, assignments, projects, quizzes) have a positive impact on my learning experience.

- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Question 3 1 pts

How many hours a week are you spending on this course?

- Less than 1 hour
- Between 1 and 2 hours
- Between 2 and 4 hours
- Between 4 and 6 hours
- Between 6 and 8 hours
- More than 8 hours per week

Question 4 1 pts

In what ways has this course helped you meet your personal or professional goals?

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Question 5 1 pts

How likely are you to recommend a course on Canvas Network to a friend?

- 0 - Not Likely
- 1
- 2
- 3
- 4
- 5 - Neutral
- 6
- 7
- 8
- 9
- 10 - Extremely Likely

Question 6 1 pts

Please give this course an overall rating on a scale of 1 to 5 with 1 being the lowest and 5 being the highest rating.

- 1 star
- 2 stars
- 3 stars
- 4 stars
- 5 stars

Question 7 1 pts

How much instructor involvement do you like to have in your online learning experiences?

- I like to learn on my own
- I prefer peer-to-peer interactions with my classmates (social learning)
- I prefer to communicate only with the instructor
- I like variety
- I do not interact with my instructor

Question 8 1 pts

Ideally, how long should Canvas Network Course last?

- 0-2 weeks
- 2-4 weeks
- 4-6 weeks
- 6-8 weeks
- 8 weeks or more

Question 9 — 1 pts

How strongly do you agree or disagree with the following statement?

I have a positive user experience when I access my course on my smartphone (e.g. iPhone, Android phone).

- I do not use a smartphone to access my course
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Question 10 — 1 pts

How strongly do you agree or disagree with the following statement?

I have a positive user experience when I access my course on my tablet device (e.g. iPad, Nexus).

- I do not use a tablet device to access my course
- Strongly Disagree
- Disagree
- Neither Agree nor Disagree
- Agree
- Strongly Agree

Question 11 — 1 pts

What discipline are you most interested in taking a course in on Canvas Network?

- Science
- Technology
- Engineering
- Humanities
- Social Science
- Business
- Applied Science

Question 12 1 pts

To what degree were PlayPosit Video Lessons better than plain videos? (rate on a scale)

- 1) PlayPosit content made no difference in my learning
- 2)
- 3)
- 4)
- 5)
- 6)
- 7) PlayPosit content deepened my understanding of course topics

Question 13 1 pts

How easy was it to use PlayPosit? (rate on a scale from difficult to easy)

- 1) Difficult
- 2)
- 3)
- 4)
- 5)
- 6)
- 7) Easy to use

Question 14 1 pts

Please rate on a scale how much you would enjoy using PlayPosit Video Lessons again.

- 1) I would not enjoy using PlayPosit again
- 2)
- 3)
- 4)
- 5)
- 6)
- 7) I would enjoy using PlayPosit again

Question 15 — 1 pts

To what degree were the Interactive PDF's better than PlayPosit? (rate on a scale)

- 1) I did not use the Interactive PDFs
- 2) I used the Interactive PDFs but preferred PlayPosit
- 3) I used both Interactive PDFs and PlayPosit
- 4) I used PlayPosit but preferred Interactive PDFs
- 5) I only used the Interactive PDFs

Question 16 — 1 pts

If you'd like to provide any general feedback on the course, please do so here:

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APPENDIX F: ONLINE DELIVERY PARTICIPATION CONSENT REQUEST.

Question 1

Not yet answered

Marked out of 1.00

Flag question

Edit question

Research Study: Designing and Evaluating MOOC (Massive Open Online Course) effectiveness within the area of Biometric Technologies, in the discipline of Forensic Science.

1. I agree to take part in the research study named above.
2. I have read and understood the Information Sheet for this study.
3. I understand that the study involves no specific requirements on my part.
4. I understand that participation involves no foreseeable risk(s).
5. I understand that all research data will be securely stored for five (5) years from the publication of the study results, and will then be securely destroyed.
6. I understand that the researcher(s) will maintain confidentiality and that any information I supply to the researcher(s) will be used only for the purposes of the research.
7. I understand that the results of the study will be published so that I cannot be identified as a participant.
8. I understand that my participation is voluntary and that I may withdraw at any time without any effect.

Select one:

- a. Yes I agree to participate in the research study
- b. No I wish to decline my participation

Appendix G: CIT Subject Evaluation: Questionnaire for students.

Overall Rating

Please rate your overall satisfaction with this subject.

1. What overall rating would you give the subject?

○ Excellent ○ Very Good ○ Good ○ Fair ○ Poor

Subject Outline

2. The subject objectives, requirements and assessment details were clearly explained to me:

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

3. The subject guide was clear and easy to follow:

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

4. The time allocated for this subject was sufficient:

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

Resources

5. The resources for this subject were sufficient:

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

6. The resources for this subject were easy to understand:

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

7. The resources for this subject were at the appropriate difficulty level

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

Teacher and Instruction

8. The teacher was knowledgeable about the subject:

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

9. The teacher was approachable, supported my learning and promoted the range of services offered by CIT:

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

10. The teacher explained things well:

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

11. The teacher encouraged participation and interaction in class:

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

12. The teacher used interesting and innovative teaching methods:

○ Strongly Agree ○ Agree ○ Neutral ○ Disagree ○ Strongly Disagree

Subject Evaluation

13. What were the best aspects of the training?

14. What were the aspects of the training that could be improved?

Appendix H: Research course variables, description, data source and recorded values.

Variable name		Variable description and data source^	Learning mode*	Values
0	CourseID	Course identification code	M, S, O	MOOC, SPOC, Online
1	LearnersEnrolled	Total number of learners who enrolled	M, S, O	MOOC, SPOC, Online
2	LearnersExplored	Total number of learners that logged into the course	M, S, O	MOOC, SPOC, Online
3	LearnersStarted	Total number of learners that started Week1 Topic 1	M, S, O	MOOC, SPOC, Online
4	LearnersCompleted	Total number of learners that completed the course including failures	M, S, O	MOOC, SPOC, Online
5	LearnersSucComp	Total number of learners that successful completed all course assessments	M, S, O	MOOC, SPOC, Online
6	LearnersFailed	Total number of learners who completed all assessments but did not pass at least one	M, S, O	MOOC, SPOC, Online
A0	ParticipantID	Unique participant code	M, S, O	Randomly generated number
A1	PrimaryRes	Primary reason for taking the course - WQ2 & CIT enrol	M, S, O	1 I like the format (online) 2 I enjoy learning about topics that interest me 3 I enjoy being part of a community of learners 4 I hope to gain skills for a new career 5 I hope to gain skills for a promotion at work 6 I am preparing to go back to school 7 I am preparing for college for the first time 8 I am curious about MOOCs 9 I want to try Canvas Network 10 No response
A2	TypeLearn	Type of online learner - WQ3	M, S	1 An observer 2 A drop-in. 3 A passive participant. 4 An active participant. 5 No response
A3	HoursperWk	Hours per week learner was planning to spend on MOOC/SPOC - WQ4	M, S, O	1 Less than 1 hour 2 Between 1 and 2 hours 3 Between 2 and 4 hours 4 Between 4 and 6 hours 5 Between 6 and 8 hours 6 More than 8 hours per week 7 No response

Variable name		Variable description and data source^	Learning mode*	Values
A4	Education	Learners highest level of education - WQ6 & CIT enrol	M, S, O	1 High School or College Preparatory School 2 Some college, but have not finished a degree 3 Completed 2-year college degree 4 Completed 4-year college degree 5 Some graduate school 6 Master's Degree (or equivalent) 7 Ph.D., J.D., or M.D. (or equivalent) 8 None of these 9 No response
A5	EnglishPrimary	English is the primary language of the learner – WQ7 & CIT enrol	M, S, O	0 No 1 Yes 2 No response
A6	PlaceLive	Place learner is currently living in – WQ8 & CIT enrol	M, S, O	1 America 2 Caribbean 3 Europe 4 African 5 Middle East 6 Asia 7 Russia 8 Australia & South Pacific 9 No response
A7	Gender	Gender of the learner- WQ9 & CIT enrol	M, S, O	0 Male 1 Female 2 No response
A8	Age	Age of the learner – WQ10 & CIT enrol	M, S, O	1 13 – 18 2 19 – 24 3 25 – 34 4 35 – 44 5 45 – 54 6 55 – 65 7 65 or older 9 No response
A9	HearCourse	Where learner heard about the course– WQ11 & CIT enrol	M, S, O	1 Through a social media site (like Facebook or Twitter) 2 From a news story (print, online, radio, or TV) that mentioned 3 Canvas Network 4 From a friend or colleague 5 I clicked on an ad 6 From a web search 7 From the instructor 8 From a Canvas or Canvas Network communication 9 No response
A10	OnlinePrev	Where learner has taken a previous online course – WQ12 & CIT enrol	M, S, O	1 Never taken an online course 2 At school 3 Canvas Network 4 Coursera 5 EdX 6 Udacity 7 Other 8 CIT 9 No response

Variable name		Variable description and data source^	Learning mode*	Values
A11	Previousonlineexp	Learner has previous online experience – WQ12 & CIT enrol	M, S, O	0 No 1 Yes 2 No response
A12	CourseMaterial	The course materials were relevant and had positive impact on the learner – UQ1 & CEQ5	M, S, O	0 No response 1 Strongly Disagree 2 Disagree 3 Neither Agree nor Disagree 4 Agree 5 Strongly Agree
A13	CourseActivities	The course activities had a positive impact on the learner – UQ2 & CEQ6	M, S, O	0 No response 1 Strongly Disagree 2 Disagree 3 Neither Agree nor Disagree 4 Agree 5 Strongly Agree
A14	CourseHrs	Time learner spent on the course – UQ3	M, S	1 Less than 1 hour 2 Between 1 and 2 hours 3 Between 2 and 4 hours 4 Between 4 and 6 hours 5 Between 6 and 8 hours 6 More than 8 hours per week 7 No response
A15	CourseRecommend	Learners likelihood of recommending the course – UQ5 & CEQ1	M, S	0 Not Likely to 9 Very Likely 10 No response
A16	RatingScale	Learners overall course star rating – UQ6 & CEQ1	M, S, O	0 No response 1 Lowest to 5 Highest
A17	InstructorInvolve	Learners preference for instructor involvement– UQ7	M, S	0 No response 1 I like to learn on my own 2 I prefer peer-to-peer interactions with my classmates (social learning) 3 I prefer to communicate only with the instructor 4 I like variety 5 I do not interact with my instructor
A18	LengCanCourse	Preferred length of a Canvas course– UQ8	M, S	1 0 – 2 weeks 2 2 – 4 weeks 3 4 – 6 weeks 4 6 – 8 weeks 5 8 weeks or more
A19	DisciplineInt	Learners discipline area of interest – UQ11	M, S	1 Science 2 Technology 3 Engineering 4 Humanities 5 Social science 6 Business 7 Applied Science
A20	InteractVid	Learners preference for interactive videos or plain videos– UQ12	M, S	1 Interactive video content made no difference in my learning to 7 Interactive video content deepened my understanding of course topics
A21	InteractUse	Learners ease of use with interactive video lessons – UQ13	M, S	0 No response 1 Difficult to 7 Easy to use
A22	InteractVidEnjoy	Learners rating on using interactive lessons in the future– UQ14	M, S	0 No response 1 I would not enjoy using video Interaction again to 7 I would enjoy using video Interaction again

Variable name		Variable description and data source^	Learning mode*	Values
A23	InteractVidPDF	Learners rating on preference between interactive PDFs and interactive video lessons – UQ15	M, S	0 No response 1 Did not use the Interactive PDFs 2 I used the interactive PDFs but preferred Video 3 I used both interactive PDFs and Video Interaction 4 I used video interaction but preferred PDFs 5 I only used the Interactive PDFs
A24	PreStGoal	Learner pre-course goals gathered from qualitative analysis of survey question - WQ5	M, S, O	1 Better understanding of topic 2 For personal interest 3 Professional development
A25	PreLExp	Learner pre-course experience gathered from qualitative analysis of survey question - WQ13	M, S	1 Course delivery style 2 Student learning experience 3 Certification
A26	PostStGoal	Learner post-course goals gathered from qualitative analysis of survey questions – UQ4	M, S	1 Enhanced career development opportunities 2 Improved knowledge of topic
A27	PostLExp	Learner post-course experience gathered from qualitative analysis of survey questions – UQ16	M, S	1 Positive learning experience 2 Variety of learning stimulus 3 Instructor presence
A28	ParticipateDiscuss	Discussion in participation is recorded as Yes for at least one post - CA	M, S	0 No 1 Yes
A29	Course_Completed	Learner completed the course - CA	M, S, O	0 No 1 Yes
A30	Date_commenced	Date the learner commenced the course (MOOC 11)	M	Date
A31	Date_completed	Date the learner completed the course (MOOC 11)	M	Date
B1	WK1QuizRes	Week 1 quiz result for learner - CA	M, S, O	Score between 0 - 10
B2	Wk2QuizRes	Week 2 quiz result for learner - CA	M, S, O	Score between 0 - 10
B3	Wk3QuizRes	Week 3 quiz result for learner - CA	M, S, O	Score between 0 - 10
B4	Wk4QuizRes	Week 4 quiz result for learner - CA	M, S, O	Score between 0 - 10
B5	AllWksFinalRes	All week's final assessment score for learner - CA	M, S, O	Proportion of results from week 1–week 4 quizzes
B6	PCourseComp	Percentage of course completed by the learner - CA	M, S, O	Proportion of course completed by learner
C1	Wk1DisNo	Number of posts learner contributed to the week 1 discussion board - CA	M, S, O	Number of posts for each learner
C2	Wk2DisNo	Number of posts learner contributed to the week 2 discussion board - CA	M, S	Number of posts for each learner

Variable name		Variable description and data source^	Learning mode*	Values
C3	Wk3DisNo	Number of posts learner contributed to the week 3 discussion board - CA	M, S	Number of posts for each learner
C4	Wk4DisNo	Number of posts learner contributed to the week 4 discussion board - CA	M, S	Number of posts for each learner
C5	TotalDisNo	Total number of learner contributions to discussion boards - CA	M, S, O	Total number of all discussion board contributions
C6	TechnicalHelp	Number of posts learner contributed to the Technical Help Forum - CA	M	Number of posts for each learner
C7	CourseQ&A	Number of posts learner contributed to the Technical Help Forum - CA	M	Number of posts for each learner
C8	IntroduceYou	Number of posts learner contributed to the Technical Help Forum - CA	M	Number of posts for each learner
C9	GeneralDis	Number of posts learner contributed to the Technical Help Forum - CA	M	Number of posts for each learner
E1	CITCourseRating	Learners overall satisfaction rating – CEQ1 & UQ6	M, S, O	1 Poor 2 Fair 3 Good 4 Very Good 5 Excellent
E2	CITSubjectObjMet	Learner was satisfied with the subject information – CEQ2	O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree
E3	CITGuideClear	Learner was satisfied with subject guide – CEQ3	O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree
E4	CITTimeAlloc	Learner was satisfied with time allocated to subject – CEQ4	O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree
E5	CITResourceSuffic	Learner was satisfied the resources were sufficient – CEQ5 & UQ1	M, S, O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree
E6	CITResourceEasy	Learner found resources easy to understand – CEQ6 & UQ2	M, S, O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree
E7	CITResourceLevel	Learner found resources were at the appropriate level – CEQ7	O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree

Variable name		Variable description and data source^	Learning mode*	Values
E8	CITTeachKnowled	Learner found the teacher was knowledgeable – CEQ8	O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree
E9	CITTeachApproach	Learner found teacher approachable – CEQ9	O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree
E10	CITTeacherExplain	Learner found teacher gave good explanations – CEQ10	O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree
E11	CITTeachPartic	Learner found teacher encouraged learner participation – CEQ11	O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree
E12	CITTeachMethods	Learner found the teacher used interesting and innovative teaching methods – CEQ12	O	1 Strongly Disagree 2 Disagree 3 Neutral 4 Agree 5 Strongly Agree

^ W – Welcome to Canvas Survey; U –User Experience Survey; CE – CIT Subject Evaluation; CIT Enrol – CIT Enrolment Form; CA – Course Analytics

* M – MOOC; S – SPOC; O – Online

Appendix I: Variables of learner completions against course pages visited.

Values used for all variables include: 0 Not Completed, 1 Completed

Variable name		Page description	Measure*
D1	Wk1ModAct	Week 1 Topic page	M, S
D2	W1T1Act	W1T1: Activity	M, S, O
D3	W1T2Act	W1T2: Activity	M, S, O
D4	W1T3Act	W1T3: Activity	M, S
D5	W1T4Act	W1T4: Activity	M, S
D6	W1T5Act	W1T5: Activity	M, S
D7	W1T6Act	W1T6: Activity	M, S
D8	W1T7Act	W1T7: Activity	M, S
D9	W1T8Act	W1T8: Activity	M, S
D10	W1T9Act	W1T9: Activity	M, S
D11	W1T10Act	W1T10: Activity	M, S
D12	Wk1AddRes	Week 1: Additional resources	M, S
D13	Wk1DisFor	Week 1: Discussion forum	M, S
D14	Wk1FinAss	Week 1: Final assessment quiz	M, S
D15	Wk2ModAct	Week 2 Topic page	M, S
D16	W2T1Act	W2T1: Activity	M, S, O
D17	W2T2Act	W2T2: Activity	M, S, O
D18	W2T3Act	W2T3: Activity	M, S
D19	W2T4Act	W2T4: Activity	M, S
D20	W2T5Act	W2T5: Activity	M, S
D21	W2T6Act	W2T6: Activity	M, S
D22	W2T7Act	W2T7: Activity	M, S
D23	W2T8Act	W2T8: Activity	M, S
D24	W2T9Act	W2T9: Activity	M, S
D25	W2T10Act	W2T10: Activity	M, S
D26	Wk2AddRes	Week 2: Additional resources	M, S
D27	Wk2DisFor	Week 2: Discussion forum	M, S
D28	Wk2FinAss	Week 2: Final assessment quiz	M, S
D29	Wk3ModAct	Week 3 Topic page	M, S
D30	W3T1Act	W3T1: Activity	M, S, O

Variable name		Page description	Measure*
D31	W3T2Act	W3T2: Activity	M, S, O
D32	W3T3Act	W3T3: Activity	M, S
D33	W3T4Act	W3T4: Activity	M, S
D34	W3T5Act	W3T5: Activity	M, S
D35	W3T6Act	W3T6: Activity	M, S
D36	W3T7Act	W3T7: Activity	M, S
D37	W3T8Act	W3T8: Activity	M, S
D38	W3T9Act	W3T9: Activity	M, S
D39	W3T10Act	W3T10: Activity	M, S
D40	W3AddRes	Week 3: Additional resources	M, S
D41	W3DisFor	Week 3: Discussion forum	M, S
D42	W3FinAss	Week 3: Final assessment quiz	M, S
D43	Wk4ModAct	Week 4 Topic page	M, S
D44	W4T1Act	W4T1: Activity	M, S, O
D45	W4T2Act	W4T2: Activity	M, S, O
D46	W4T3Act	W4T3: Activity	M, S
D47	W4T4Act	W4T4: Activity	M, S
D48	W4T5Act	W4T5: Activity	M, S
D49	W4T6Act	W4T6: Activity	M, S
D50	W4T7Act	W4T7: Activity	M, S
D51	W4T8Act	W4T8: Activity	M, S
D52	WT9Act	W4T9: Activity	M, S
D53	W4T10Act	W4T10: Activity	M, S
D54	Wk4AddRes	Week 4: Additional resources	M, S
D55	Wk4DisFor	Week 4: Discussion forum	M, S
D56	Wk4FinAss	Week 4: Final assessment quiz	M, S

* M (MOOC), S (SPOC), O (Online)

Appendix J: Data management plan for the research study.

Project title	VOOM Model: Digital Learning Excellence in VET MOOCs.
Description	This project seeks to make a significant contribution to technology-rich delivery in the Vocational Education and Training (VET) sector through the development of a best-practice model, which maximises student retention and fosters greater levels of learner engagement. The MOOCs (Massive Open Online Courses) initial design is based on pedagogically sound online and MOOC delivery concepts and quality educational design practices. The analysis of student engagement and learner retention in the VET environment will be explored through SPOC (Small Private Online Courses) and online delivered courses which will be correlated against the MOOC learning experience. This research is an evolutionary process evaluating MOOCs, SPOCs and online course delivery over multiple iterations.
Start Date	14 September 2015
Finish Date	21 January 2019
Funding Source	Canberra Institute of Technology
Grant Number	
Principal Investigator and Collaborators	Andrew Fluck, Joel Scanlan, Rachael Paton
Ethics approval number	H0015193
Data Collection and Storage	
Data Manager	Andrew Fluck, UTAS and Rachael Paton, CIT
Type of Data	CIT semester-based Program Review and Improvement statistics reports and information correlated in terms of: enrolled numbers, student attrition and success rate. Alternative learning environments: Student engagement and retention will be analysed by using the CIT Enrolment Form or CIT eLearn to ascertain students who attended and participated in weeks 1, 2, 8, 14. MOOC delivery: Student engagement and retention will be evaluated against enrolled numbers, students who started the subject, students who finish the week 1, 2, 3 of work and students who successfully complete the whole subject. Analysis of student interaction in MOOC delivery with both the video tutorials and written learning resources will also be considered to draw out patterns in student behaviour. Welcome to Canvas Network – Survey is used to ascertain the student's reasons for taking the subject, highest level of education, demographics, gender, and level of education etc. and is taken before the student commences week 1 of the learning materials. The User Experience Survey is completed after the final subject assessment to determine how well the student enjoyed the course and suggested comments for change to the subject etc. CIT subject evaluation is completed: at the end of the semester (16 weeks) for each subject of study and is used to evaluate the content, delivery and learners satisfaction.

Data Collection Methodology	3 anonymous electronic surveys, CIT Enrolment forms, CIT Program Review and Improvement reports, Excel, SPSS, CIT BANNER, CIT eLearn, Canvas.net
Use of Existing or 3rd Party Data	Approval has been gained from Canberra Institute of Technology to use 3rd party data.
Size/amount of Data	1 TB of video and photographs 500 MB stored data
Data Storage Location	All analysed paper-based research documents will be stored in a locked filing cabinet and electronic format will be stored on a secure password protected encrypted USB drive. Both document types will be stored in a locked filing cabinet in a locked office within the Forensic Science Department at CIT, Bruce campus, 35 Vowels Crescent, Bruce ACT 2617 to ensure confidentiality and privacy of these materials.
Expected File Formats	.jpg, .xlsx, .csv, .docx, .sav, .spv, .amosp
Specific retention and disposal issues	All electronic and paper-based files will be held securely for a minimum of 5 years following the publication of the thesis. Retained research data and/or primary materials, will be stored in long-term storage within the University or an appropriate data repository. The electronic and paper-based research documents supplied to the Chief Investigator – Andrew Fluck will be securely stored on his password secured computer. All hard copy data will be filed securely in a locked filing cabinet at the University of Tasmania to preserve for 5 years following the publication of the thesis. Data that does not need to be retained will be securely destroyed. Electronic files will be deleted from the Chief Investigator and Student Investigator computer hard-drives, computer rubbish bins and organisational servers. Paper documents will be cross-cut shredded and put into a confidential recycle bin.
Access and Discovery	
Data privacy, confidentiality or sensitivity issues	The CIT Enrolment Form is an identifying form which will be analysed to identify student engagement and retention. Attendance and subject participation will be recorded. Research data will be anonymised through transcoding the identifiable participant data to a unique research identifier. The assignment of these research identifiers to enrolment information and open questions from survey instruments will be undertaken by the Forensic Administration Officer. As such the researchers will not be able to identify individual participants from the CIT enrolment information based on their survey participation.

Licensing, copyright restrictions or data ownership issues	N/A
Level of data access to be provided	Closed to researchers.
Contact person for data access	Andrew Fluck, 03 6324 3284, andrew.fluck@utas.edu.au Rachael Paton, 02 62074943, rachael.paton@cit.edu.au
Metadata repository for data discovery	UTAS Research Data Discovery Service

Appendix K: Summary data for MOOC 1–10 against study variables.

Variable	MOOC 1	MOOC 2	MOOC 3	MOOC 4	MOOC 5	MOOC 6	MOOC 7	MOOC 8	MOOC 9	MOOC 10
Course dates	Sept 15 – Oct 15	Nov 15 – Dec 15	Mar 16 – Apr 16	May 16 – Jun 16	Aug 16 – Sep 16	Oct 16 – Nov 16	Feb 17 – Mar 17	May 17 – May 17	Sep 17 – Oct 17	Nov 17 – Dec 17
1 Learners enrolled	734	474	347	194	146	218	100	84	104	165
2 Learners explored	385	312	197	105	98	92	62	52	74	79
3 Learners started W1T1	154	103	91	48	57	46	51	25	67	71
4 Learners completed course	117	63	38	38	44	15	30	20	33	37
5 Learners successfully completed course	114	60	36	36	44	15	30	19	31	37
6 Learners failed course	3	3	2	2	0	0	0	1	2	0
Student withdrawal Enrolled-Explored	349	162	150	89	48	126	38	32	30	86
Student withdrawal Explored-Started	231	209	106	57	41	46	11	27	7	8
Completed/Enrolled	16%	13%	11%	20%	30%	7%	30%	24%	32%	22%
Completed/Explored	30%	20%	19%	36%	45%	16%	48%	38%	45%	47%
Completed/Started W1T1	76%	61%	42%	79%	77%	33%	59%	80%	49%	52%
Success/Enrolled	16%	13%	10%	19%	30%	7%	30%	23%	30%	22%
Success/Explored	30%	19%	18%	34%	45%	16%	48%	37%	42%	47%
Success/Started W1T1	74%	58%	40%	75%	77%	33%	59%	76%	46%	52%
Failed/Enrollers	0%	1%	1%	1%	0%	0%	0%	1%	2%	0%
Failed/Explored	1%	1%	1%	2%	0%	0%	0%	2%	3%	0%
Failed/Started W1T1	2%	3%	2%	4%	0%	0%	0%	4%	3%	0%

Appendix L: Summary data for SPOC 1–5 against study variables.

Variable	SPOC 1	SPOC 2	SPOC 3	SPOC 4	SPOC 5
Course dates	Jul 15 – Sep 15	Feb 16 – Apr 16	Jul 16 – Sep 16	Feb 17 – Apr 17	Jul 17 – Sep 17
1 Learners enrolled	16	10	8	13	19
2 Learners explored	15	8	8	12	18
3 Learners started W1T1	15	7	8	12	18
4 Learners completed course	11	6	5	11	17
5 Learners successfully completed course	11	6	5	11	17
6 Learners failed course	0	0	0	0	0
Student withdrawal Enrolled-Explored	1	2	0	1	1
Student withdrawal Explored-Started	0	1	0	0	0
Completed/Enrolled	69%	60%	63%	85%	89%
Completed/Explored	73%	75%	63%	92%	94%
Completed/Started W1T1	73%	86%	63%	92%	94%
Success/Enrolled	69%	60%	63%	85%	89%
Success/Explored	73%	75%	63%	92%	94%
Success/Started W1T1	73%	86%	63%	92%	94%
Failed/Enrollers	0%	0%	0%	0%	0%
Failed/Explored	0%	0%	0%	0%	0%
Failed/Started W1T1	0%	0%	0%	0%	0%

Appendix M: Summary data for MOOC 1–10 and SPOC 1–5 against each research predicator: Assessment, Discussion, Content, Instructor.

Variable	Assessment pass mark		Discussion requirements		Content flow		Instructor accessibility #				
	60%*	100%^	Compulsory	Optional	Systematic	Flexible	i1	i2	i3	i4	i5
1 Learners enrolled	2147	485	2147	485	1601	1031	1224	551	372	197	288
2 Learners explored	1220	298	1220	298	972	546	712	310	198	126	172
3 Learners started W1T1	529	244	529	244	473	300	272	146	111	88	156
4 Learners completed course	337	148	337	148	320	165	191	82	64	61	87
5 Learners successfully completed course	327	145	327	145	312	160	185	78	64	60	85
6 Learners failed course	10	3	10	3	8	5	6	4	0	1	2
Student withdrawal Enrolled-Explored	927	187	927	187	629	485	512	241	174	71	116
Student withdrawal Explored-Started	691	54	691	54	499	246	440	164	87	38	16
Completed/Enrolled	32.0%	47.0%	32.0%	47.0%	42.7%	32.6%	32.7%	30.2%	33.2%	46.1%	47.9%
Completed/Explored	42.0%	60.6%	42.0%	60.6%	52.3%	46.2%	41.3%	43.5%	41.2%	59.5%	61.8%
Completed/Started W1T1	65.5%	71.1%	65.5%	71.1%	69.1%	66.1%	70.2%	68.9%	57.4%	76.8%	65.3%
Success/Enrolled	31.7%	46.5%	31.7%	46.5%	42.4%	32.2%	32.3%	29.6%	33.2%	45.7%	47%
Success/Explored	41.5%	59.9%	41.5%	59.9%	51.8%	45.5%	40.7%	42.5%	41.2%	58.9%	61%
Success/Started W1T1	64.2%	69.9%	64.2%	69.9%	68.1%	64.7%	68.5%	66.8%	57.4%	75.5%	64%
Failed/Enrollers	0.3%	0.5%	0.3%	0.5%	0.4%	0.4%	0.3%	0.5%	0.0%	0.4%	1%
Failed/Explored	0.5%	0.8%	0.5%	0.8%	0.6%	0.7%	0.6%	1.0%	0.0%	0.6%	1%
Failed/Started W1T1	1.2%	1.2%	1.2%	1.2%	1.0%	1.5%	1.6%	2.1%	0.0%	1.3%	1%

* The learners must get at least 60% in all four final assessments in two attempts.

^ The learners must get 100% in all four final assessments with unlimited attempts.

i1: Initial welcome and fortnightly article link; i2: Initial welcome, fortnightly article link; i3: Initial welcome, weekly article link and beginning week summary; i4: Initial welcome, weekly article link, beginning week summary and increased teacher chat on discussions; i5: Initial welcome, weekly article link, beginning week summary, increased teacher chat on discussions and motivational emails to learners.

Appendix N: Summary data for Online Delivered Courses 1–5 against study variables.

Course	Online 1	Online 2	Online 3	Online 4	Online 5
Course dates	Jul 15 – Dec 15	Feb 16 – Jun 16	Jul 16 – Dec 16	Feb 17 – Jun 17	Jul 17 – Dec 17
1 Learners enrolled	18	26	12	28	26
2 Learners explored	11	6	8	16	21
3 Learners started W1T1	11	6	8	16	21
4 Learners completed course	10	5	7	14	17
5 Learners successfully completed course	10	4	7	14	17
6 Learners failed course	0	1	0	0	0
Student withdrawal Enrolled-Explored	7	20	4	12	5
Student withdrawal Explored-Started	0	0	0	0	0
Completed/Enrolled	56%	19%	58%	50%	65%
Completed/Explored	91%	83%	88%	88%	81%
Completed/Started W1T1	91%	83%	88%	88%	81%
Success/Enrolled	56%	15%	58%	50%	65%
Success/Explored	91%	67%	88%	88%	81%
Success/Started W1T1	91%	67%	88%	88%	81%
Failed/Enrollers	0%	4%	0%	0%	0%
Failed/Explored	0%	17%	0%	0%	0%
Failed/Started W1T1	0%	17%	0%	0%	0%

Appendix O: Summary data for MOOC 11 (a–e), SPOC 6 and online 6.

Variable	MOOC 11*	MOOC 11a	MOOC 11b	MOOC 11c	MOOC 11d	MOOC 11e	SPOC 6	Online 6
Course dates	Jan 18 – Feb 18	Jan 18 – Feb 18	Feb 18 – Mar 18	Mar 18 – Apr 18	Apr 18 – May 18	May 18 – Jun 18	Feb 18 – Mar 18	Feb 18 – Jun 18
1 Learners enrolled	397	194	63	67	34	39	32	65
2 Learners explored	270	143	40	42	21	24	29	64
3 Learners started W1T1	108	57	16	17	9	9	29	64
4 Learners completed course	76	40	11	12	6	7	28	50
5 Learners successfully completed course	76	40	11	12	6	7	28	50
6 Learners failed course	0	0	0	0	0	0	0	0
Student withdrawal Enrolled-Explored	127	51	23	25	13	15	4	15
Student withdrawal Explored-Started	162	86	24	25	12	15	0	0
Completed/Enrolled	19%	21%	17%	18%	18%	18%	88%	77%
Completed/Explored	28%	28%	28%	29%	29%	29%	97%	78%
Completed/Started W1T1	70%	70%	69%	71%	67%	78%	97%	78%
Success/Enrolled	19%	21%	17%	18%	18%	18%	88%	77%
Success/Explored	28%	28%	28%	29%	29%	29%	97%	78%
Success/Started W1T1	70%	70%	69%	71%	67%	78%	97%	78%
Failed/Enrollers	0%	0%	0%	0%	0%	0%	0%	0%
Failed/Explored	0%	0%	0%	0%	0%	0%	0%	0%
Failed/Started W1T1	0%	0%	0%	0%	0%	0%	0%	0%

* Combined totals for MOOC 11a–11e.

APPENDIX P: DESCRIPTIVE STATISTICS AND CATEGORICAL FREQUENCIES FOR STUDY VARIABLES FOR ALL DELIVERY MODES.

Descriptive statistics for assessments and discussion variables for all delivery modes

Variable	n	Min	Max	Mean	Std. Dev	Skewness		Kurtosis	
						Statistic	S. E.	Statistic	S. E.
B1 Week 1 Quiz Result	522	0	10	8.78	2.051	-2.658	.107	7.961	.213
B2 Week 2 Quiz Result	455	0	10	9.06	2.018	-3.340	.114	11.843	.228
B3 Week 3 Quiz Result	432	0	10	8.82	2.341	-2.798	.117	7.507	.234
B4 Week 4 Quiz Result	414	0	10	8.68	2.442	-2.707	.120	6.783	.239
B5 Weekly Final Assessment Score	683	0	40	23.65	16.852	-.432	.094	-1.602	.187
B6 % Course Completed	683	0	1.00	0.69	0.401	-.725	.094	-1.281	.187
C1 Week 1: Discussion Number	368	1	3	1.09	0.308	3.374	.127	11.363	.254
C2 Week 2: Discussion Number	284	1	7	1.05	0.391	12.932	.145	191.214	.288
C3 Week 3: Discussion Number	266	1	8	1.05	0.500	12.112	.149	155.756	.298
C4 Week 4: Discussion Number	256	1	7	1.05	0.435	11.474	.152	145.735	.303
C5 Total Discussions Number	683	0	23	2.10	2.348	1.636	.094	8.505	.187

Categorical frequencies for study variables for all delivery modes

A1 Primary Reason for MOOC	Frequency	%	Valid %	Cumulative %
I like the format (online)	46	6.7	6.7	6.7
I enjoy learning about topics that interest me	284	41.6	41.6	48.3
I enjoy being part of a community of learners	33	4.8	4.8	53.1
I hope to gain skills for a new career	157	23.0	23.0	76.1
I hope to gain skills for a promotion at work	55	8.1	8.1	84.2
I am preparing to go back to school	25	3.7	3.7	87.8
I am preparing for college for the first time	4	.6	.6	88.4
I am curious about MOOCs	53	7.8	7.8	96.2
I want to try Canvas Network	12	1.8	1.8	98.0
Other	14	2.0	2.0	100.0
Total	683	100.0	100.0	

A2 Type of Learner	Frequency	%	Valid %	Cumulative %
An observer	38	5.6	5.6	5.6
A drop-in	30	4.4	4.4	10.0
A passive participant	181	26.5	26.5	36.5
An active participant	338	49.5	49.5	85.9
No response	96	14.1	14.1	100.0
Total	683	100.0	100.0	

A3 Hours per Week	Frequency	%	Valid %	Cumulative %
Less than 1 hour	14	2.0	2.0	2.0
Between 1 and 2 hours	124	18.2	18.2	20.2
Between 2 and 4 hours	241	35.3	35.3	55.5
Between 4 and 6 hours	127	18.6	18.6	74.1
Between 6 and 8 hours	43	6.3	6.3	80.4
More than 8 hours per week	34	5.0	5.0	85.4
No response	100	14.6	14.6	100.0
Total	683	100.0	100.0	

A4 Level of Education	Frequency	%	Valid %	Cumulative %
High School or College Preparatory School	90	13.2	13.2	13.2
Some college, but have not finished a degree	83	12.2	12.2	25.3
Completed 2-year college degree	54	7.9	7.9	33.2
Completed 4-year college degree	170	24.9	24.9	58.1
Some graduate school	63	9.2	9.2	67.3
Master's Degree (or equivalent)	137	20.1	20.1	87.4
PhD, JD, or MD (or equivalent)	41	6.0	6.0	93.4
None of these	31	4.5	4.5	98.0
No response	14	2.0	2.0	100.0
Total	683	100.0	100.0	

A5 English Primary Language	Frequency	%	Valid %	Cumulative %
No	250	36.6	36.6	36.6
Yes	425	62.2	62.2	98.8
No response	8	1.2	1.2	100.0
Total	683	100.0	100.0	

A6 Place Living	Frequency	%	Valid %	Cumulative %
America	131	19.2	19.2	19.2
Caribbean	11	1.6	1.6	20.8
Europe	95	13.9	13.9	34.7
Africa	96	14.1	14.1	48.8
Middle East	16	2.3	2.3	51.1
Asia	72	10.5	10.5	61.6
Russia	1	.1	.1	61.8
Australia & South Pacific	254	37.2	37.2	99.0
No response	7	1.0	1.0	100.0
Total	683	100.0	100.0	

A7 **Gender**	Frequency	%	Valid %	Cumulative %
Male	400	58.6	58.6	58.6
Female	268	39.2	39.2	97.8
No response	15	2.2	2.2	100.0
Total	683	100.0	100.0	

A8 **Age**	Frequency	%	Valid %	Cumulative %
19–24	128	18.7	18.7	18.7
25–34	192	28.1	28.1	46.9
35–44	167	24.5	24.5	71.3
45–54	115	16.8	16.8	88.1
55–64	59	8.6	8.6	96.8
65 or older	12	1.8	1.8	98.5
No response	10	1.5	1.5	100.0
Total	683	100.0	100.0	

A9 **Hear Course**	Frequency	%	Valid %	Cumulative %
Through a social media site (like Facebook or Twitter)	57	8.3	8.3	8.3
From a news story (print, online, radio, or TV) that mentioned	14	2.0	2.0	10.4
Canvas Network	29	4.2	4.2	14.6
From a friend or colleague	108	15.8	15.8	30.5
I clicked on an ad	23	3.4	3.4	33.8
From a web search	155	22.7	22.7	56.5
From the instructor	151	22.1	22.1	78.6
From a Canvas or Canvas Network communication	121	17.7	17.7	96.3
No response	25	3.7	3.7	100.0
Total	683	100.0	100.0	

A10 **Previous Online Course**	Frequency	%	Valid %	Cumulative %
Never taken an online course	130	19.0	19.0	19.0
At school	79	11.6	11.6	30.6
Canvas Network	127	18.6	18.6	49.2
Coursera	76	11.1	11.1	60.3
EdX	27	4.0	4.0	64.3
Udacity	15	2.2	2.2	66.5
Other	136	19.9	19.9	86.4
CIT	93	13.6	13.6	100.0
Total	683	100.0	100.0	

A11 **Previous Online Experience**	Frequency	%	Valid %	Cumulative %
No	130	19.0	19.0	19.0
Yes	553	81.0	81.0	100.0
Total	683	100.0	100.0	

A12 **Positive Impact Course Material**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	15	2.2	4.9	4.9
	Disagree	2	.3	.6	5.5
	Neither Agree nor Disagree	11	1.6	3.6	9.1
	Agree	137	20.1	44.5	53.6
	Strongly Agree	143	20.9	46.4	100.0
	Total	308	45.1	100.0	
Missing	System	375	54.9		
Total		683	100.0		

A13 **Positive Impact Course Activities**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	11	1.6	3.6	3.6
	Disagree	4	.6	1.3	5.0
	Neither Agree nor Disagree	13	1.9	4.3	9.2
	Agree	159	23.3	52.5	61.7
	Strongly Agree	116	17.0	38.3	100.0
	Total	303	44.4	100.0	
Missing	System	380	55.6		
Total		683	100.0		

A14 **Course Hours Student Spends**		Frequency	%	Valid %	Cumulative %
	Less than 1 hour	5	.7	1.7	1.7
	Between 1 and 2 hours	45	6.6	14.9	16.6
	Between 2 and 4 hours	116	17.0	38.4	55.0
	Between 4 and 6 hours	75	11.0	24.8	79.8
	Between 6 and 8 hours	33	4.8	10.9	90.7
	More than 8 hours per week	28	4.1	9.3	100.0
	Total	302	44.2	100.0	
Missing	System	381	55.8		
Total		683	100.0		

A15 **Course Recommendation**		Frequency	%	Valid %	Cumulative %
	1 Not Likely	4	.6	1.3	1.3
	2	4	.6	1.3	2.7
	3	2	.3	.7	3.3
	4	2	.3	.7	4.0
	5 Neutral	17	2.5	5.7	9.7
	6	17	2.5	5.7	15.3
	7	39	5.7	13.0	28.3
	8	56	8.2	18.7	47.0
	9	32	4.7	10.7	57.7
	10 Very Likely	127	18.6	42.3	100.0
	Total	300	43.9	100.0	
Missing	System	383	56.1		
Total		683	100.0		

A16 **Course Overall Rating Scale**		Frequency	%	Valid %	Cumulative %
	1	5	.7	1.7	1.7
	2	7	1.0	2.3	4.0
	3	25	3.7	8.3	12.3
	4	119	17.4	39.7	52.0
	5 Highest	144	21.1	48.0	100.0
	Total	300	43.9	100.0	
Missing	System	383	56.1		
Total		683	100.0		

A17 **Instructor Involvement**		Frequency	%	Valid %	Cumulative %
	I like to learn on my own	70	10.2	23.4	23.4
	I prefer peer-to-peer interactions with my classmates (social learning)	14	2.0	4.7	28.1
	I prefer to communicate only with the instructor	41	6.0	13.7	41.8
	I like variety	164	24.0	54.8	96.7
	I do not interact with my instructor	10	1.5	3.3	100.0
	Total	299	43.8	100.0	
Missing	System	384	56.2		
Total		683	100.0		

A18 **Length of Canvas Course**		Frequency	%	Valid %	Cumulative %
	0–2 weeks	7	1.0	2.3	2.3
	2–4 weeks	102	14.9	34.0	36.3
	4–6 weeks	129	18.9	43.0	79.3
	6–8 weeks	38	5.6	12.7	92.0
	8 weeks or more	24	3.5	8.0	100.0
	Total	300	43.9	100.0	
Missing	System	383	56.1		
Total		683	100.0		

A19 **Discipline Interest**		Frequency	%	Valid %	Cumulative %
	Science	48	7.0	16.0	16.0
	Technology	136	19.9	45.3	61.3
	Engineering	23	3.4	7.7	69.0
	Humanities	22	3.2	7.3	76.3
	Social Science	29	4.2	9.7	86.0
	Business	15	2.2	5.0	91.0
	Applied Science	27	4.0	9.0	100.0
	Total	300	43.9	100.0	
Missing	System	383	56.1		
Total		683	100.0		

A20 Video Interaction for Learning		Frequency	%	Valid %	Cumulative %
	0 No comment	3	.4	1.0	1.0
	1 Interactive video content made no difference in my learning	59	8.6	20.5	21.5
	2	9	1.3	3.1	24.7
	3	20	2.9	6.9	31.6
	4	34	5.0	11.8	43.4
	5	61	8.9	21.2	64.6
	6	32	4.7	11.1	75.7
	7 Interactive video content deepened my understanding of course topics	70	10.2	24.3	100.0
	Total	288	42.2	100.0	
Missing	System	395	57.8		
Total		683	100.0		

A21 Video Interaction usage		Frequency	%	Valid %	Cumulative %
	0 No comment	3	.4	1.0	1.0
	1 Difficult	17	2.5	5.9	6.9
	2	14	2.0	4.8	11.8
	3	15	2.2	5.2	17.0
	4	51	7.5	17.6	34.6
	5	39	5.7	13.5	48.1
	6	37	5.4	12.8	60.9
	7 Easy to use	113	16.5	39.1	100.0
	Total	289	42.3	100.0	
Missing	System	394	57.7		
Total		683	683	100.0	

A22 Video Interaction for enjoyment		Frequency	%	Valid %	Cumulative %
	0 No comment	3	.4	1.0	1.0
	1 I would not enjoy using Video Interaction again	22	3.2	7.6	8.7
	2	11	1.6	3.8	12.5
	3	18	2.6	6.3	18.8
	4	53	7.8	18.4	37.2
	5	53	7.8	18.4	55.6
	6	37	5.4	12.8	68.4
	7 I would enjoy using Video Interaction again	91	13.3	31.6	100.0
	Total	288	42.2	100.0	
Missing	System	395	57.8		
Total		683	100.0		

A23 **PDFs vs Video Interaction**		Frequency	%	Valid %	Cumulative %
	0 No comment	3	.4	1.8	1.8
	1 Did not use the Interactive PDFs	25	3.7	14.6	16.4
	2 I used the Interactive PDFs but preferred Video	12	1.8	7.0	23.4
	3 I used both Interactive PDFs and Video Interaction	70	10.2	40.9	64.3
	4 I used Video Interaction but preferred PDFs	23	3.4	13.5	77.8
	5 I only used the Interactive PDFs	38	5.6	22.2	100.0
	Total	171	25.0	100.0	
Missing	System	512	75.0		
Total		683	100.0		

A24 **Pre-course Learner Goals**		Frequency	%	Valid %	Cumulative %
	Better understanding of topic	125	18.3	28.2	28.2
	For personal interest	132	19.3	29.7	57.9
	Professional development	187	27.4	42.1	100.0
	Total	444	65.0	100.0	
Missing	System	239	35.0		
Total		683	100.0		

A25 **Pre-course Learner Experience**		Frequency	%	Valid %	Cumulative %
	Course delivery style	45	6.6	28.0	28.0
	Student learning experience	89	13.0	55.3	83.2
	Certification	27	4.0	16.8	100.0
	Total	161	23.6	100.0	
Missing	System	522	76.4		
Total		683	100.0		

A26 **Post-course Learner Goals**		Frequency	%	Valid %	Cumulative %
	Enhanced career development opportunities	52	7.6	38.2	38.2
	Improved knowledge of topic	84	12.3	61.8	100.0
	Total	136	19.9	100.0	
Missing	System	547	80.1		
Total		683	100.0		

A27 **Post-course Learner Experience**		Frequency	%	Valid %	Cumulative %
	Positive learning experience	162	23.7	68.4	68.4
	Variety of learning stimulus	51	7.5	21.5	89.9
	Instructor presence	24	3.5	10.1	100.0
	Total	237	34.7	100.0	
Missing	System	446	65.3		
Total		683	100.0		

A28 **Participation in Discussions**		Frequency	%	Valid %	Cumulative %
	No	271	39.7	39.7	39.7
	Yes	412	60.3	60.3	100.0
	Total	683	100.0	100.0	

A29 **Learners Completed Course**	Frequency	%	Valid %	Cumulative %
No	287	42.0	42.0	42.0
Yes	396	58.0	58.0	100.0
Total	683	100.0	100.0	

Appendix Q: Crosstabs for C5 Total Discussion Number variable for MOOC, SPOC, and Online delivery modes.

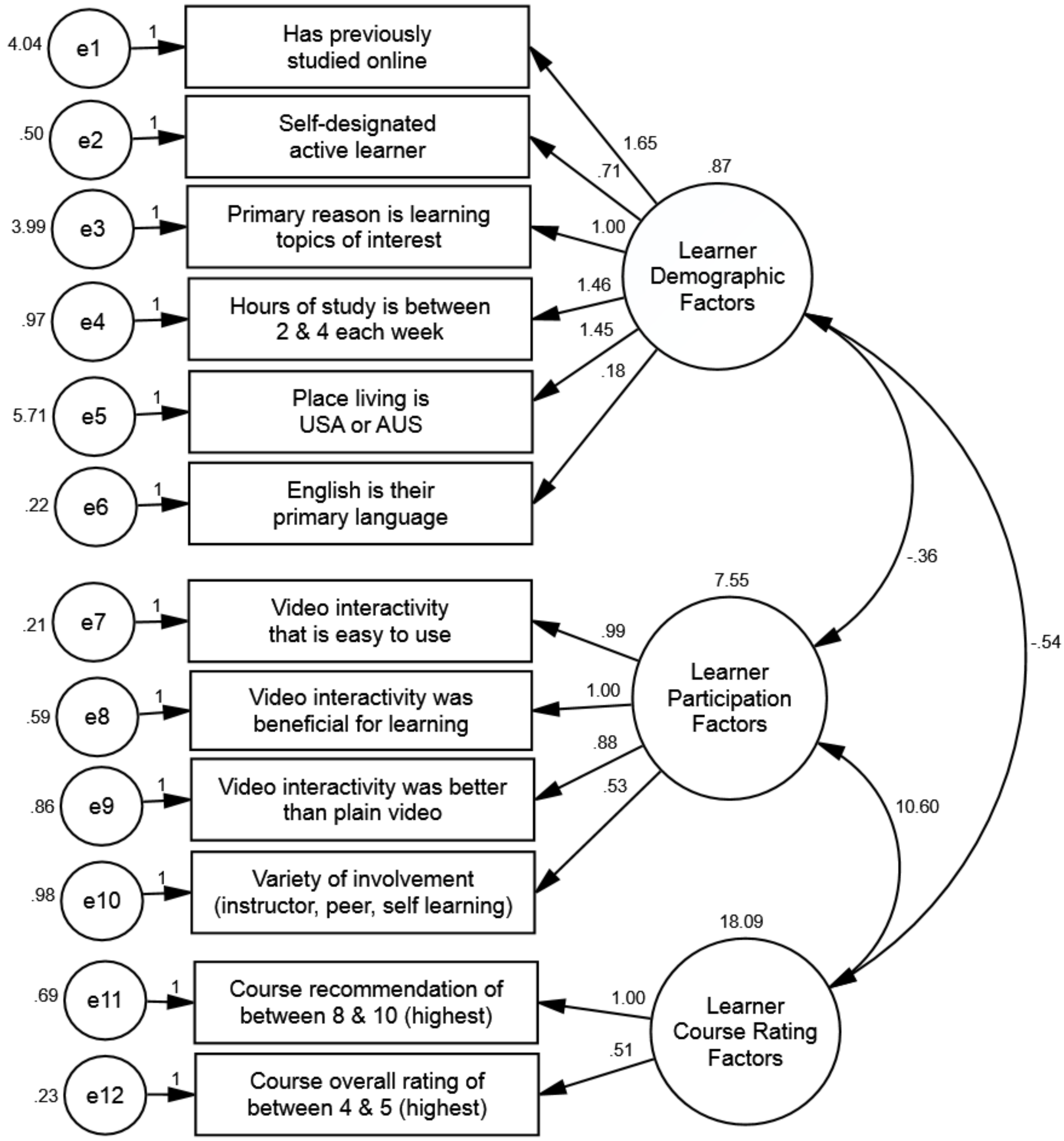
Course	Total number of discussion contributions by learner													
	0	1	2	3	4	5	6	7	8	9	10	12	23	Total
MOOC1	27	10	6	1	38	24	8	3	1	2	0	1	0	121
MOOC2	26	16	4	2	22	7	3	0	1	0	0	0	1	82
MOOC3	21	9	1	3	8	3	1	2	0	0	0	0	0	48
MOOC4	5	8	3	4	13	5	3	1	0	0	0	0	0	42
MOOC5	9	5	2	2	15	3	0	3	1	0	0	0	0	40
MOOC6	6	4	3	2	4	6	0	0	0	0	0	0	0	25
MOOC7	15	1	0	0	4	3	1	1	0	0	1	0	0	26
MOOC8	21	0	0	1	8	4	0	0	0	1	0	0	0	35
MOOC9	11	3	0	1	3	0	0	0	0	0	0	0	0	18
MOOC10	23	7	4	2	3	0	0	0	0	0	0	0	0	39
MOOC11a	20	3	1	1	2	2	1	0	0	0	0	0	0	30
MOOC11b	4	1	1	0	0	0	0	0	0	0	0	0	0	6
MOOC11c	12	2	0	1	0	1	0	0	0	0	0	0	0	16
MOOC11d	4	0	1	1	0	0	0	0	0	0	0	0	0	6
MOOC11e	7	1	0	0	1	0	0	0	0	0	0	0	0	9
SPOC1	0	0	0	0	4	2	0	0	0	0	0	0	0	6
SPOC2	0	0	0	0	2	0	0	0	0	0	0	0	0	2
SPOC3	0	1	0	0	3	0	0	0	0	0	0	0	0	4
SPOC4	1	0	0	0	5	2	0	0	0	0	0	0	0	8
SPOC5	1	0	1	1	7	0	0	0	0	0	0	0	0	10
SPOC6	4	3	2	0	4	4	0	0	0	0	0	0	0	17
Online1	11	3	0	0	0	0	0	0	0	0	0	0	0	14
Online2	4	0	4	0	0	0	0	0	0	0	0	0	0	8
Online3	9	1	0	0	0	0	0	0	0	0	0	0	0	10
Online4	7	8	0	0	0	0	0	0	0	0	0	0	0	15
Online5	11	6	9	0	0	0	0	0	0	0	0	0	0	26
Online6	12	8	0	0	0	0	0	0	0	0	0	0	0	20
Total	271	100	42	22	146	66	17	10	3	3	1	1	1	683

Appendix R: Confirmatory factor analysis and structured equation modelling analysis for Model 1, Model 2, Model 3, and Model 4.

MODEL 1: Standardised and Unstandardised coefficients table for confirmatory factor analysis.

Observed variable	Latent construct	β	B	SE	r^2
A1 Primary reason for taking course	Learner demographic factors	0.423	1.000		0.179
A2 Type of learner	Learner demographic factors	0.681	0.707	0.074	0.463
A3 Hrs per week of study	Learner demographic factors	0.809	1.455	0.148	0.655
A5 English primary language	Learner demographic factors	0.343	0.185	0.028	0.117
A6 Place living	Learner demographic factors	0.492	1.446	0.175	0.242
A10 Previous online course	Learner demographic factors	0.607	1.647	0.180	0.368
A15 Course recommendation	Learner course rating factors	0.981	1.000		0.963
A16 Course overall rating scale	Learner course rating factors	0.976	0.507	0.006	0.953
A17 Instructor involvement	Learner participation factors	0.827	0.529	0.015	0.686
A20 Video interaction learning	Learner participation factors	0.934	0.882	0.016	0.872
A21 Video interaction use	Learner participation factors	0.963	1.000		0.927
A22 Video interaction enjoyment	Learner participation factors	0.986	0.988	0.013	0.972

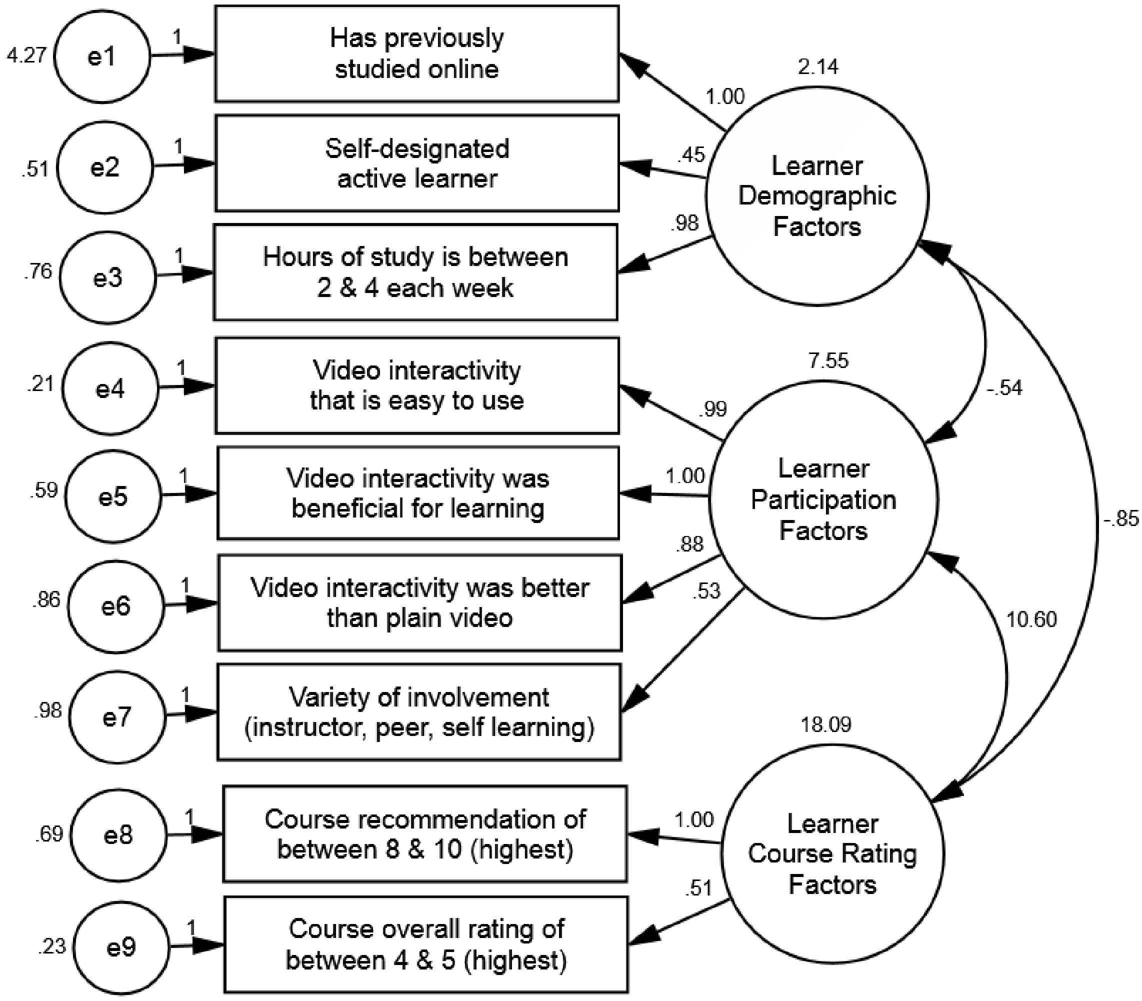
MODEL 1. Results of confirmatory analysis and structural equation modelling of unstandardised coefficients.



MODEL 2. Standardised and Unstandardised coefficients table for confirmatory factor analysis.

Observed variable	Latent construct	β	B	SE	r^2
A2 Type of learner	Learner demographic factors	0.678	0.449	0.036	0.459
A3 Hrs per week of study	Learner demographic factors	0.855	0.981	0.084	0.731
A10 Previous online course	Learner demographic factors	0.578	1.000		0.334
A15 Course recommendation	Learner course rating factors	0.981	1.000		0.963
A16 Course overall rating scale	Learner course rating factors	0.976	0.507	0.006	0.953
A17 Instructor involvement	Learner participation factors	0.827	0.529	0.015	0.684
A20 Video interaction learning	Learner participation factors	0.934	0.882	0.016	0.872
A21 Video interaction use	Learner participation factors	0.963	1.000		0.927
A22 Video interaction enjoyment	Learner participation factors	0.986	0.988	0.013	0.972

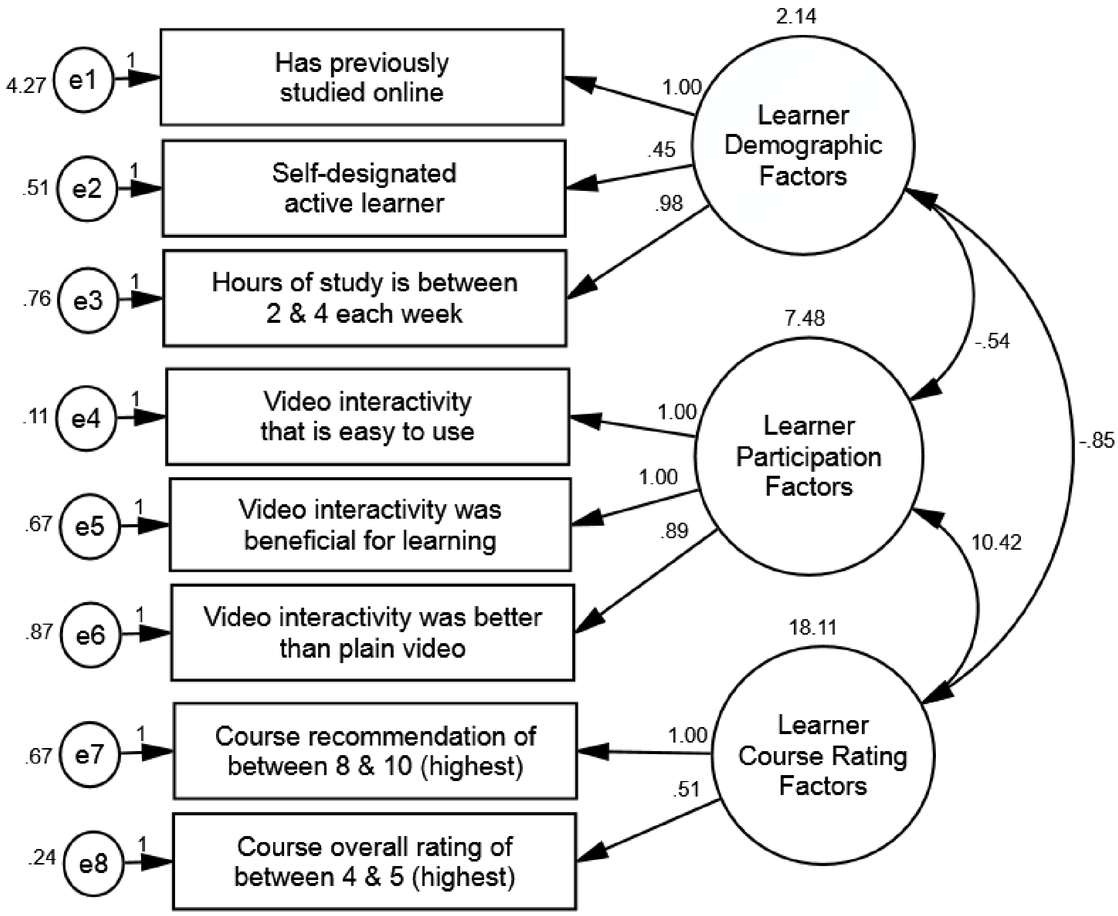
MODEL 2. Results of confirmatory analysis and structural equation modelling of unstandardised coefficients.



MODEL 3: Standardised and Unstandardised coefficients table for confirmatory factor analysis.

Observed variable	**Latent construct**	**β**	**B**	**SE**	**r^2**
A2 Type of learner	Learner demographic factors	0.678	0.449	0.036	0.459
A3 Hrs per week of study	Learner demographic factors	0.855	0.981	0.084	0.731
A10 Previous online course	Learner course rating factors	0.578	1.000		0.334
A15 Course recommendation	Learner course rating factors	0.982	1.000		0.964
A16 Course overall rating scale	Learner participation factors	0.975	0.507	0.006	0.951
A20 Video interaction learning	Learner demographic factors	0.934	0.886	0.017	0.871
A21 Video interaction use	Learner participation factors	0.958	1.000		0.918
A22 Video interaction enjoyment	Learner participation factors	0.993	1.000	0.013	0.986

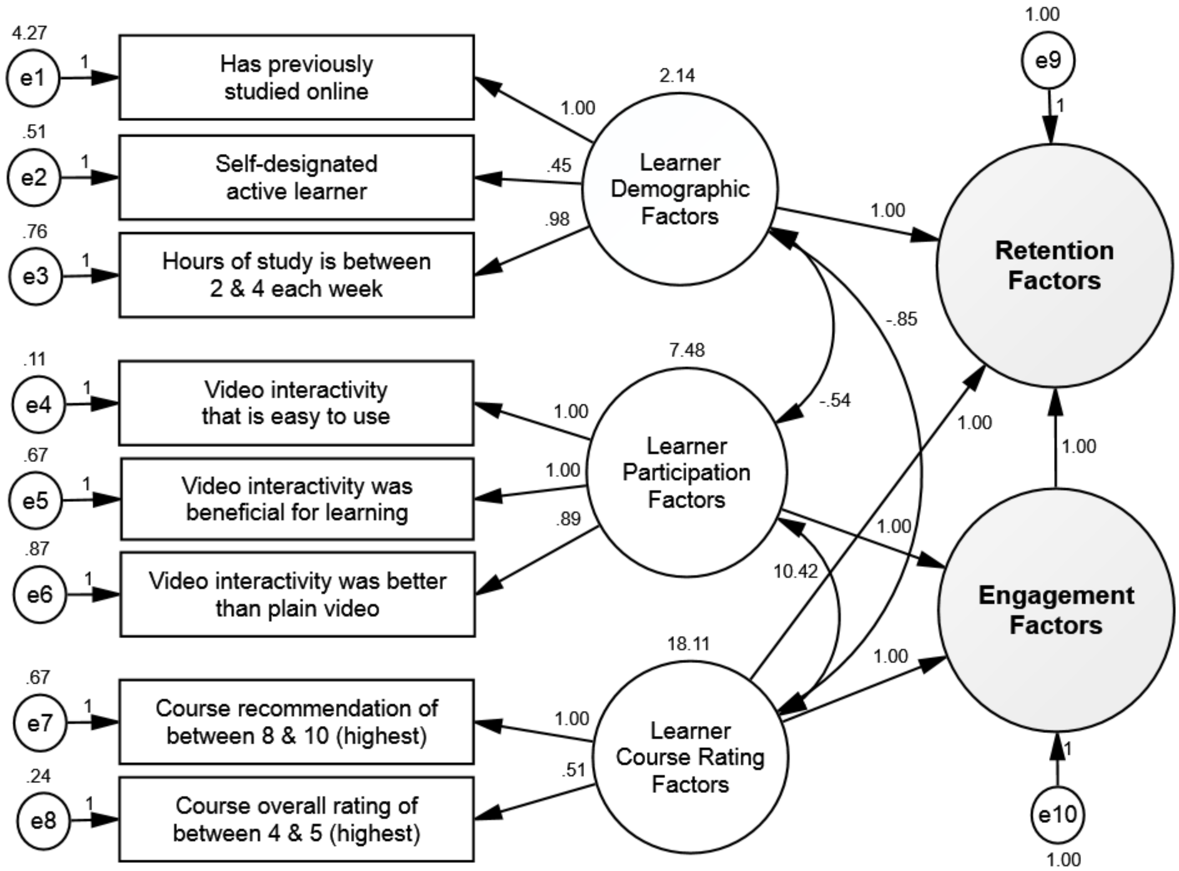
MODEL 3. Results of confirmatory analysis and structural equation modelling of unstandardised coefficients.



MODEL 4: Standardised and Unstandardised coefficients table for confirmatory factor analysis.

Observed variable	Latent construct	β	B	SE	r^2
Retention					0.979
Engagement					0.992
Retention	Engagement	0.63	1.00		
Retention	Learner demographic factors	0.13	1.00		
Retention	Learner course rating factors	0.39	1.00		
Engagement	Learner course rating factors	0.62	1.00		
Engagement	Learner participation factors	0.40	1.00		
A2 Type of learner	Learner demographic factors	0.68	0.45	0.04	0.459
A3 Hrs per week of study	Learner demographic factors	0.86	0.98	0.08	0.731
A10 Previous online course	Learner course rating factors	0.99	1.00	0.01	0.334
A15 Course recommendation	Learner course rating factors	0.96	1.00		0.964
A16 Course overall rating scale	Learner participation factors	0.98	0.51	0.01	0.951
A20 Video interaction learning	Learner demographic factors	0.93	0.87	0.02	0.871
A21 Video interaction use	Learner participation factors	0.96	1.00		0.918
A22 Video interaction enjoyment	Learner participation factors	0.99	1.00	0.02	0.986

MODEL 4. Results of confirmatory analysis and structural equation modelling of unstandardised coefficients.



MODEL 4. Two-sided bias-corrected percentile method (BC) for two tailed significance and upper and lower standardised and unstandardised total, direct and indirect effects.

Total Effects - Lower Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	1.000	1.000	.000
Retention factors	2.000	1.000	1.000
A16 Course overall rating	.488	.000	.000
A15 Course recommendation	1.000	.000	.000
A20 Video interaction learning	.000	.844	.000
A21 Video interaction use	.000	1.000	.000
A22 Video interaction enjoyment	.000	.969	.000
A3 Hrs per week of study	.000	.000	.859
A2 Type of learner	.000	.000	.397
A10 Previous online course	.000	.000	1.000

Total Effects - Upper Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	1.000	1.000	.000
Retention factors	2.000	1.000	1.000
A16 Course overall rating	.523	.000	.000
A15 Course recommendation	1.000	.000	.000
A20 Video interaction learning	.000	.925	.000
A21 Video interaction use	.000	1.000	.000
A22 Video interaction enjoyment	.000	1.031	.000
A3 Hrs per week of study	.000	.000	1.138
A2 Type of learner	.000	.000	.512
A10 Previous online course	.000	.000	1.000

Total Effects - Two Tailed Significance (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	...	...	...
Retention factors	...	...	...
A16 Course overall rating	.001	...	...
A15 Course recommendation	...	...	...
A20 Video interaction learning	...	.001	...
A21 Video interaction use	...	...	...
A22 Video interaction enjoyment	...	.001	...
A3 Hrs per week of study	...	...	.001
A2 Type of learner	...	...	.001
A10 Previous online course	...	...	...

Standardised Total Effects - Lower Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	.607	.388	.000
Retention factors	.761	.241	.115
A16 Course overall rating	.955	.000	.000
A15 Course recommendation	.967	.000	.000
A20 Video interaction learning	.000	.914	.000
A21 Video interaction use	.000	.945	.000
A22 Video interaction enjoyment	.000	.979	.000
A3 Hrs per week of study	.000	.000	.788
A2 Type of learner	.000	.000	.618
A10 Previous online course	.000	.000	.511

Standardised Total Effects - Upper Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	.629	.406	.000
Retention factors	.784	.255	.151
A16 Course overall rating	.990	.000	.000
A15 Course recommendation	.994	.000	.000
A20 Video interaction learning	.000	.948	.000
A21 Video interaction use	.000	.970	.000
A22 Video interaction enjoyment	.000	1.001	.000
A3 Hrs per week of study	.000	.000	.913
A2 Type of learner	.000	.000	.733
A10 Previous online course	.000	.000	.641

Standardised Total Effects - Two Tailed Significance (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	.001	.001	...
Retention factors	.001	.001	.001
A16 Course overall rating	.002	...	...
A15 Course recommendation	.001	...	...
A20 Video interaction learning	...	.002	...
A21 Video interaction use	...	.001	...
A22 Video interaction enjoyment	...	.002	...
A3 Hrs per week of study	...	...	.001
A2 Type of learner	...	...	.001
A10 Previous online course	...	...	.001

Direct Effects - Lower Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	1.000	1.000	.000
Retention factors	1.000	.000	1.000
A16 Course overall rating	.488	.000	.000
A15 Course recommendation	1.000	.000	.000
A20 Video interaction learning	.000	.844	.000
A21 Video interaction use	.000	1.000	.000
A22 Video interaction enjoyment	.000	.969	.000
A3 Hrs per week of study	.000	.000	.859
A2 Type of learner	.000	.000	.397
A10 Previous online course	.000	.000	1.000

Direct Effects - Upper Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	1.000	1.000	.000
Retention factors	1.000	.000	1.000
A16 Course overall rating	.523	.000	.000
A15 Course recommendation	1.000	.000	.000
A20 Video interaction learning	.000	.925	.000
A21 Video interaction use	.000	1.000	.000
A22 Video interaction enjoyment	.000	1.031	.000
A3 Hrs per week of study	.000	.000	1.138
A2 Type of learner	.000	.000	.512
A10 Previous online course	.000	.000	1.000

Direct Effects - Two Tailed Significance (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	...	...	...
Retention factors	...	...	...
A16 Course overall rating	.001	...	...
A15 Course recommendation	...	...	...
A20 Video interaction learning	...	.001	...
A21 Video interaction use	...	...	...
A22 Video interaction enjoyment	...	.001	...
A3 Hrs per week of study	...	...	.001
A2 Type of learner	...	...	.001
A10 Previous online course	...	...	...

Standardised Direct Effects - Lower Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	.607	.388	.000
Retention factors	.381	.000	.115
A16 Course overall rating	.955	.000	.000
A15 Course recommendation	.967	.000	.000
A20 Video interaction learning	.000	.914	.000
A21 Video interaction use	.000	.945	.000
A22 Video interaction enjoyment	.000	.979	.000
A3 Hrs per week of study	.000	.000	.788
A2 Type of learner	.000	.000	.618
A10 Previous online course	.000	.000	.511

Standardised Direct Effects - Upper Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	.629	.406	.000
Retention factors	.392	.000	.151
A16 Course overall rating	.990	.000	.000
A15 Course recommendation	.994	.000	.000
A20 Video interaction learning	.000	.948	.000
A21 Video interaction use	.000	.970	.000
A22 Video interaction enjoyment	.000	1.001	.000
A3 Hrs per week of study	.000	.000	.913
A2 Type of learner	.000	.000	.733
A10 Previous online course	.000	.000	.641

Standardised Direct Effects - Two Tailed Significance (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	.001	.001	...
Retention factors	.001	...	.001
A16 Course overall rating	.002	...	...
A15 Course recommendation	.001	...	...
A20 Video interaction learning	...	.002	...
A21 Video interaction use	...	.001	...
A22 Video interaction enjoyment	...	.002	...
A3 Hrs per week of study	...	...	.001
A2 Type of learner	...	...	.001
A10 Previous online course	...	...	.001

Indirect Effects - Lower Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	.000	.000	.000
Retention factors	1.000	1.000	.000
A16 Course overall rating	.000	.000	.000
A15 Course recommendation	.000	.000	.000
A20 Video interaction learning	.000	.000	.000
A21 Video interaction use	.000	.000	.000
A22 Video interaction enjoyment	.000	.000	.000
A3 Hrs per week of study	.000	.000	.000
A2 Type of learner	.000	.000	.000
A10 Previous online course	.000	.000	.000

Indirect Effects - Upper Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	.000	.000	.000
Retention factors	1.000	1.000	.000
A16 Course overall rating	.000	.000	.000
A15 Course recommendation	.000	.000	.000
A20 Video interaction learning	.000	.000	.000
A21 Video interaction use	.000	.000	.000
A22 Video interaction enjoyment	.000	.000	.000
A3 Hrs per week of study	.000	.000	.000
A2 Type of learner	.000	.000	.000
A10 Previous online course	.000	.000	.000

Indirect Effects - Two Tailed Significance (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	...	...	...
Retention factors	...	...	...
A16 Course overall rating	...	...	...
A15 Course recommendation	...	...	...
A20 Video interaction learning	...	...	...
A21 Video interaction use	...	...	...
A22 Video interaction enjoyment	...	...	...
A3 Hrs per week of study	...	...	...
A2 Type of learner	...	...	...
A10 Previous online course	...	...	...

Standardised Indirect Effects - Lower Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	.000	.000	.000
Retention factors	.381	.241	.000
A16 Course overall rating	.000	.000	.000
A15 Course recommendation	.000	.000	.000
A20 Video interaction learning	.000	.000	.000
A21 Video interaction use	.000	.000	.000
A22 Video interaction enjoyment	.000	.000	.000
A3 Hrs per week of study	.000	.000	.000
A2 Type of learner	.000	.000	.000
A10 Previous online course	.000	.000	.000

Standardised Indirect Effects - Upper Bounds (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	.000	.000	.000
Retention factors	.392	.255	.000
A16 Course overall rating	.000	.000	.000
A15 Course recommendation	.000	.000	.000
A20 Video interaction learning	.000	.000	.000
A21 Video interaction use	.000	.000	.000
A22 Video interaction enjoyment	.000	.000	.000
A3 Hrs per week of study	.000	.000	.000
A2 Type of learner	.000	.000	.000
A10 Previous online course	.000	.000	.000

Standardised Indirect Effects - Two Tailed Significance (BC)	Learner Course Rating Factors	Learner Participation Factors	Learner Demographic Factors
Engagement factors	...	...	...
Retention factors	.001	.001	...
A16 Course overall rating	...	...	...
A15 Course recommendation	...	...	...
A20 Video interaction learning	...	...	...
A21 Video interaction use	...	...	...
A22 Video interaction enjoyment	...	...	...
A3 Hrs per week of study	...	...	...
A2 Type of learner	...	...	...
A10 Previous online course	...	...	...

Appendix S: Descriptive Statistics for MOOC 1 control group.

Hypothesis test	***Md***	***n***
H_1: Learner's primary reason for taking the course	1	121
H_2: Learner's highest level of education	1	121
H_3: Learner with English as their primary language	1	121
H_4: Learner's place of residence	1	121
H_5: Learner's gender	1	121
H_6: Learner's age	1	121
H_7: Where the learner has taken a previous online course	1	121
H_8: Learner has previous online experience	1	121
H_9: The course materials were relevant and had a positive impact on the learner	1	68
H_{10}: The course activities had a positive impact on the learner	1	67
H_{11}: Learner's overall course star rating	1	68
H_{12}: Learner's preference for instructor involvement	1	68
H_{13}: Learner's Week 1 quiz result	1	88
H_{14}: Learner's Week 2 quiz result	1	79
H_{15}: Learner's Week 3 quiz result	1	77
H_{16}: Learner's Week 4 quiz result	1	77
H_{17}: Learner's final assessment score for all weeks	1	121
H_{18}: Percentage of course completed by the learner	1	121
H_{19}: Learner's number of contributions to the week 1 discussion board	1	89
H_{20}: Total number of learner contributions to discussion boards	1	121
H_{21}: Learner's pre-course goals	1	110
H_{22}: Learner's pre-course experience	1	21
H_{23}: Learner's post-course goals	1	21
H_{24}: Learner's post-course experience	1	69

Appendix T: Mann-Whitney U Test results for comparison of MOOC/SPOC/online learning modes (MOOC 2–11, SPOC 1–6, Online 1–6) against MOOC 1 control group.

Hypothesis test	Md	*n*	*U*	*z*	*p*	*r*	*Effect*
H_1: Learner's primary reason for taking the course	2	683	31756.5	-1.19	0.233	0.05	
H^2: Learner's highest level of education	2	683	32627.5	-0.71	0.479	0.03	
H^3: Learner with English as their primary language	2	683	32860.0	-0.69	0.492	0.03	
H^4: Learner's place of residence	2	683	25482.5	-4.47	0.000	0.17	Small
H^5: Learner's gender	2	683	33811.5	-0.11	0.911	0.00	
H^6: Learner's age	2	683	32925.5	-0.56	0.575	0.02	
H^7: Where the learner has taken a previous online course	2	683	28576.0	-2.79	0.005	0.11	Small
H^8: Learner has previous online experience	2	683	33670.0	-0.25	0.805	0.01	
H^9: The course materials were relevant and had a positive impact on the learner	2	308	7615.0	-0.93	0.351	0.05	
H^{10}: The course activities had a positive impact on the learner	2	303	6819.0	-1.92	0.055	0.11	
H^{11}: Learner's overall course star rating	2	300	6629.5	-2.20	0.028	0.13	Small
H^{12}: Learner's preference for instructor involvement	2	299	7228.0	-1.10	0.270	0.06	
H^{13}: Learner's Week 1 quiz result	2	522	15924.0	-2.67	0.008	0.12	Small
H^{14}: Learner's Week 2 quiz result	2	455	13230.5	-1.76	0.078	0.08	
H^{15}: Learner's Week 3 quiz result	2	432	10598.0	-3.43	0.001	0.17	Small
H^{16}: Learner's Week 4 quiz result	2	414	9040.5	-4.36	0.000	0.21	Small
H^{17}: Learner's final assessment score for all weeks	2	683	30737.0	-1.69	0.092	0.06	
H^{18}: Percentage of course completed by the learner	2	683	33016.0	-0.55	0.581	0.02	
H^{19}: Learner's number of contributions to the week 1 discussion board	2	368	12375.5	-0.09	0.925	0.00	
H^{20}: Total number of learner contributions to discussion boards	2	683	21673.0	-6.52	0.000	0.25	Small
H^{21}: Learner's pre-course goals	2	444	17064.000	-1.20	0.232	0.06	
H^{22}: Learner's pre-course experience	2	161	1308.000	-0.91	0.365	0.07	
H^{23}: Learner's post-course goals	2	136	733.500	-3.32	0.001	0.28	Small
H^{24}: Learner's post-course experience	2	237	4423.500	-3.50	0.000	0.23	Small

Note: Variable significance levels p<.05 are highlighted in green.

APPENDIX U: MANN-WHITNEY U TEST RESULTS FOR COMPARISON OF MOOC/SPOC LEARNING MODES (MOOC 2–11 AND SPOCS 1–6) AGAINST MOOC 1 CONTROL GROUP.

Hypothesis test	**Md**	***n***	***U***	***z***	***p***	***r***	***Effect***
H_1: Learner's primary reason for taking the course	2	590	27449.5	-0.59	0.557	0.02	
H^2: Learner's highest level of education	2	590	25483.5	-1.75	0.079	0.07	
H^3: Learner with English as their primary language	2	590	26281.0	-1.46	0.144	0.06	
H^4: Learner's place of residence	2	590	24275.0	-2.50	0.012	0.10	Small
H^5: Learner's gender	2	590	27483.5	-0.63	0.530	0.03	
H^6: Learner's age	2	590	27804.0	-0.35	0.727	0.01	
H^7: Where the learner has taken a previous online course	2	590	28173.0	-0.12	0.902	0.00	
H^8: Learner has previous online experience	2	590	27589.5	-0.65	0.513	0.03	
H^9: The course materials were relevant and had a positive impact on the learner	2	303	7457.0	-0.93	0.353	0.05	
H^{10}: The course activities had a positive impact on the learner	2	298	6721.5	-1.83	0.068	0.11	
H^{11}: Learner's overall course star rating	2	295	6563.5	-2.06	0.039	0.12	Small
H^{12}: Learner's preference for instructor involvement	2	294	7078.0	-1.09	0.275	0.06	
H^{13}: Learner's Week 1 quiz result	2	429	12540.5	-2.55	0.011	0.12	Small
H^{14}: Learner's Week 2 quiz result	2	362	9602.5	-2.21	0.027	0.12	Small
H^{15}: Learner's Week 3 quiz result	2	339	7291.5	-4.10	0.000	0.22	Small
H^{16}: Learner's Week 4 quiz result	2	322	5434.5	-5.89	0.000	0.33	Medium
H^{17}: Learner's final assessment score for all weeks	2	590	26901.0	-0.90	0.370	0.04	
H^{18}: Percentage of course completed by the learner	2	590	26944.5	-0.94	0.349	0.04	
H^{19}: Learner's number of contributions to the week 1 discussion board	2	338	10760.0	-0.93	0.353	0.05	
H_{20}: Total number of learner contributions to discussion boards	2	590	19592.0	-5.44	0.000	0.22	Small
H_{21}: Learner's pre-course goals	2	444	17064.0	-1.19	0.232	0.06	
H_{22}: Learner's pre-course experience	2	161	1308.0	-0.91	0.365	0.07	
H_{23}: Learner's post-course goals	2	136	733.5	-3.39	0.001	0.29	Small
H_{24}: Learner's post-course experience	2	237	4423.5	-3.50	0.000	0.23	Small

Note: Variable significance levels p<.05 are highlighted in green.

Appendix V: Mann-Whitney U Test results for comparison of MOOC learning mode (MOOC 2–11) against MOOC 1 control group.

Hypothesis test	Md	*n*	*U*	*z*	*p*	*r*	*Effect*
H_1: Learner's primary reason for taking the course	2	543	24192.5	-0.94	0.347	0.04	
H^2: Learner's highest level of education	2	546	22110.0	-2.29	0.022	0.10	Small
H^3: Learner with English as their primary language	2	547	22618.5	-2.21	0.027	0.09	Small
H^4: Learner's place of residence	2	548	23711.0	-1.22	0.223	0.05	
H^5: Learner's gender	2	549	23802.5	-1.36	0.173	0.06	
H^6: Learner's age	2	550	25271.5	-0.17	0.861	0.01	
H^7: Where the learner has taken a previous online course	2	552	25407.5	-0.08	0.934	0.00	
H^8: Learner has previous online experience	2	553	25331.5	-0.19	0.851	0.01	
H^9: The course materials were relevant and had a positive impact on the learner	2	268	6442.0	-0.72	0.472	0.04	
H^{10}: The course activities had a positive impact on the learner	2	263	5867.5	-1.44	0.150	0.09	
H^{11}: Learner's overall course star rating	2	260	5843.0	-1.43	0.153	0.09	
H^{12}: Learner's preference for instructor involvement	2	259	6161.5	-0.70	0.484	0.04	
H^{13}: Learner's Week 1 quiz result	2	384	11691.0	-1.54	0.123	0.08	
H^{14}: Learner's Week 2 quiz result	2	318	8499.0	-1.50	0.133	0.08	
H^{15}: Learner's Week 3 quiz result	2	295	6552.0	-3.09	0.002	0.18	Small
H^{16}: Learner's Week 4 quiz result	2	278	4915.5	-4.87	0.000	0.29	Small
H^{17}: Learner's final assessment score for all weeks	2	543	24889.5	-0.43	0.668	0.02	
H^{18}: Percentage of course completed by the learner	2	543	23651.0	-1.34	0.179	0.06	
H^{19}: Learner's number of contributions to the week 1 discussion board	2	299	9091.5	-0.84	0.402	0.05	
H_{20}: Total number of learner contributions to discussion boards	2	543	16892.5	-5.90	0.000	0.25	Small
H_{21}: Learner's pre-course goals	2	406	15574.5	-0.71	0.475	0.04	
H_{22}: Learner's pre-course experience	2	135	1098.0	-0.68	0.494	0.06	
H_{23}: Learner's post-course goals	2	117	613.5	-3.31	0.001	0.31	Medium
H_{24}: Learner's post-course experience	2	218	4040.5	-3.18	0.001	0.22	Small

Note: Variable significance levels *p*<.05 are highlighted in green.

Appendix W: Mann-Whitney U Test results for comparison of SPOC learning mode (SPOC 1–6) against MOOC 1 control group.

Hypothesis test	Md	*n*	*U*	*z*	*p*	*r*	*Effect*
H_1: Learner's primary reason for taking the course	1	168	2430.0	-1.54	0.125	0.12	
H^2: Learner's highest level of education	1	168	2313.5	-1.91	0.057	0.15	
H^3: Learner with English as their primary language	1	168	2024.5	-3.86	0.000	0.30	Small
H^4: Learner's place of residence	1	168	564.0	-8.47	0.000	0.65	Large
H^5: Learner's gender	1	168	2006.0	-3.38	0.001	0.26	Small
H^6: Learner's age	1	168	2532.5	-1.13	0.258	0.09	
H^7: Where the learner has taken a previous online course	1	168	2765.5	-0.28	0.777	0.02	
H^8: Learner has previous online experience	1	168	2258.0	-2.74	0.006	0.21	Small
H^9: The course materials were relevant and had a positive impact on the learner	1	103	1015.0	-1.36	0.172	0.13	
H^{10}: The course activities had a positive impact on the learner	1	102	854.0	-2.56	0.010	0.25	Small
H^{11}: Learner's overall course star rating	1	103	720.5	-3.62	0.000	0.36	Medium
H^{12}: Learner's preference for instructor involvement	1	30	849.5	-5.78	0.000	1.06	Very Large
H^{13}: Learner's Week 1 quiz result	1	133	1103.5	-3.86	0.000	0.33	Medium
H^{14}: Learner's Week 2 quiz result	1	123	739.5	-5.60	0.000	0.50	Large
H^{15}: Learner's Week 3 quiz result	1	121	519.0	-6.47	0.000	0.59	Large
H^{16}: Learner's Week 4 quiz result	1	121	728.5	-7.57	0.000	0.69	Large
H^{17}: Learner's final assessment score for all weeks	1	103	916.5	-2.13	0.033	0.21	Small
H^{18}: Percentage of course completed by the learner	1	168	2393.5	-1.89	0.059	0.15	
H^{19}: Learner's number of contributions to the week 1 discussion board	1	128	1668.5	-0.75	0.456	0.07	
H_{20}: Total number of learner contributions to discussion boards	1	168	2699.5	-0.53	0.598	0.04	
H_{21}: Learner's pre-course goals	1	148	1489.5	-2.8	0.004	0.23	Small
H_{22}: Learner's pre-course experience	1	47	210.0	-1.4	0.139	0.20	
H_{23}: Learner's post-course goals	1	40	120.0	-2.4	0.013	0.38	Medium
H_{24}: Learner's post-course experience	1	88	383.0	-3.7	0.000	0.39	Medium

Note: Variable significance levels *p*<.05 are highlighted in green.

Appendix X: Mann-Whitney U Test results for comparison of Online learning mode (Online 1–6) against MOOC 1 control group.

Hypothesis test	Md	*n*	*U*	*z*	*p*	*r*	*Effect*
H_1: Learner's primary reason for taking the course	1	214	2443.5	-7.23	0.000	0.50	Medium
H^2: Learner's highest level of education	1	214	4104.5	-3.39	0.001	0.23	Small
H^3: Learner with English as their primary language	1	214	4633.5	-2.76	0.006	0.19	Small
H^4: Learner's place of residence	1	214	1195.5	-10.75	0.000	0.74	Very Large
H^5: Learner's gender	1	214	4519.5	-2.68	0.007	0.18	Small
H^6: Learner's age	1	214	5113.5	-1.05	0.295	0.07	
H^7: Where the learner has taken a previous online course	1	214	0.0	-13.09	0.000	0.90	Very Large
H^8: Learner has previous online experience	1	214	4462.0	-4.52	0.000	0.31	Medium
H^9: The course materials were relevant and had a positive impact on the learner	No responses from online learners						
H^{10}: The course activities had a positive impact on the learner	No responses from online learners						
H^{11}: Learner's overall course star rating	No responses from online learners						
H^{12}: Learner's preference for instructor involvement	No responses from online learners						
H^{13}: Learner's Week 1 quiz result	2	181	3313.0	-2.23	0.025	0.17	Small
H^{14}: Learner's Week 2 quiz result	2	172	3558.0	-0.26	0.794	0.02	
H^{15}: Learner's Week 3 quiz result	2	170	3229.5	-1.05	0.295	0.08	
H^{16}: Learner's Week 4 quiz result	2	169	3465.5	-0.12	0.902	0.01	
H^{17}: Learner's final assessment score for all weeks	1	214	3764.5	-4.09	0.000	0.28	Small
H^{18}: Percentage of course completed by the learner	1	214	5143.0	-1.11	0.267	0.08	
H^{19}: Learner's number of contributions to the week 1 discussion board	1	119	1054.5	-2.83	0.005	0.26	Small
H_{20}: Total number of learner contributions to discussion boards	1	214	2081	-8.17	0.000	0.56	Large
H_{21}: Learner's pre-course goals	No responses from online learners						
H_{22}: Learner's pre-course experience	No responses from online learners						
H_{23}: Learner's post-course goals	No responses from online learners						
H_{24}: Learner's post-course experience	No responses from online learners						

Note: Variable significance levels p<.05 are highlighted in green.

Appendix Y: Weekly activity progression frequencies for MOOCs, SPOCs, and Online learners.

D1

Week 1: Module Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	53	7.8	10.4	10.4
	Completed	456	66.8	89.6	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D2

W1T1: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	67	9.8	11.1	11.1
	Completed	535	78.3	88.9	100.0
	Total	602	88.1	100.0	
Missing	System	81	11.9		
Total		683	100.0		

D3

W1T2: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	80	11.7	13.3	13.3
	Completed	522	76.4	86.7	100.0
	Total	602	88.1	100.0	
Missing	System	81	11.9		
Total		683	100.0		

D4

W1T3: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	58	8.5	11.4	11.4
	Completed	451	66.0	88.6	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D5

W1T4: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	72	10.5	14.1	14.1
	Completed	437	64.0	85.9	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D6

W1T5: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	82	12.0	16.1	16.1
	Completed	427	62.5	83.9	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D7 **W1T6: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	91	13.3	17.9	17.9
	Completed	418	61.2	82.1	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D8 **W1T7: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	96	14.1	18.9	18.9
	Completed	413	60.5	81.1	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D9 **W1T8: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	97	14.2	19.1	19.1
	Completed	412	60.3	80.9	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D10 **W1T9: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	100	14.6	19.6	19.6
	Completed	409	59.9	80.4	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D11 **W1T10: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	105	15.4	20.6	20.6
	Completed	404	59.2	79.4	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D12 **Week 1: Additional Resources**		Frequency	%	Valid %	Cumulative %
	Not Completed	121	17.7	23.8	23.8
	Completed	388	56.8	76.2	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D13 **Week 1: Discussion Forum**		Frequency	%	Valid %	Cumulative %
	Not Completed	112	16.4	22.0	22.0
	Completed	397	58.1	78.0	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D14 **Week 1: Final Assessment Quiz**		Frequency	%	Valid %	Cumulative %
	Not Completed	132	19.3	25.9	25.9
	Completed	377	55.2	74.1	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D15 **Week 2: Module Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	132	19.3	25.9	25.9
	Completed	377	55.2	74.1	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D16 **W2T1: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	173	25.3	28.7	28.7
	Completed	429	62.8	71.3	100.0
	Total	602	88.1	100.0	
Missing	System	81	11.9		
Total		683	100.0		

D17 **W2T2: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	180	26.4	29.9	29.9
	Completed	422	61.8	70.1	100.0
	Total	602	88.1	100.0	
Missing	System	81	11.9		
Total		683	100.0		

D18 **W2T3: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	145	21.2	28.5	28.5
	Completed	364	53.3	71.5	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D19 **W2T4: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	148	21.7	29.1	29.1
	Completed	361	52.9	70.9	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D20 **W2T5: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	150	22.0	29.5	29.5
	Completed	359	52.6	70.5	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D21 **W2T6: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	150	22.0	29.5	29.5
	Completed	359	52.6	70.5	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D22 **W2T7: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	151	22.1	29.7	29.7
	Completed	358	52.4	70.3	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D23 **W2T8: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	153	22.4	30.1	30.1
	Completed	356	52.1	69.9	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D24 **W2T9: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	152	22.3	29.9	29.9
	Completed	357	52.3	70.1	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D25 **W2T10: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	152	22.3	29.9	29.9
	Completed	357	52.3	70.1	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D26 **Week 2: Additional Resources**		Frequency	%	Valid %	Cumulative %
	Not Completed	167	24.5	32.8	32.8
	Completed	342	50.1	67.2	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D27 **Week 2: Discussion Forum**		Frequency	%	Valid %	Cumulative %
	Not Completed	159	23.3	31.2	31.2
	Completed	350	51.2	68.8	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D28 **Week 2: Final Assessment Quiz**		Frequency	%	Valid %	Cumulative %
	Not Completed	158	23.1	31.0	31.0
	Completed	351	51.4	69.0	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D29 **Week 3: Module Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	130	19.0	25.5	25.5
	Completed	379	55.5	74.5	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D30 **W3T1: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	202	29.6	33.6	33.6
	Completed	400	58.6	66.4	100.0
	Total	602	88.1	100.0	
Missing	System	81	11.9		
Total		683	100.0		

D31 **W3T2: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	204	29.9	33.9	33.9
	Completed	398	58.3	66.1	100.0
	Total	602	88.1	100.0	
Missing	System	81	11.9		
Total		683	100.0		

D32 **W3T3: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	162	23.7	31.8	31.8
	Completed	347	50.8	68.2	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D33 **W3T4: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	162	23.7	31.8	31.8
	Completed	347	50.8	68.2	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D34

W3T5: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	163	23.9	32.0	32.0
	Completed	346	50.7	68.0	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D35

W3T6: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	163	23.9	32.0	32.0
	Completed	346	50.7	68.0	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D36

W3T7: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	163	23.9	32.0	32.0
	Completed	346	50.7	68.0	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D37

W3T8: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	165	24.2	32.4	32.4
	Completed	344	50.4	67.6	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D38

W3T9: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	166	24.3	32.6	32.6
	Completed	343	50.2	67.4	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D39

W3T10: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	168	24.6	33.0	33.0
	Completed	341	49.9	67.0	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D40 **Week 3: Additional Resources**		Frequency	%	Valid %	Cumulative %
	Not Completed	177	25.9	34.8	34.8
	Completed	332	48.6	65.2	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D41 **Week 3: Discussion Forum**		Frequency	%	Valid %	Cumulative %
	Not Completed	181	26.5	35.6	35.6
	Completed	328	48.0	64.4	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D42 **Week 3: Final Assessment Quiz**		Frequency	%	Valid %	Cumulative %
	Not Completed	172	25.2	33.8	33.8
	Completed	337	49.3	66.2	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D43 **Week 4: Module Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	158	23.1	31.0	31.0
	Completed	351	51.4	69.0	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D44 **W4T1: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	212	31.0	35.2	35.2
	Completed	390	57.1	64.8	100.0
	Total	602	88.1	100.0	
Missing	System	81	11.9		
Total		683	100.0		

D45 **W4T2: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	214	31.3	35.5	35.5
	Completed	388	56.8	64.5	100.0
	Total	602	88.1	100.0	
Missing	System	81	11.9		
Total		683	100.0		

D46 **W4T3: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	172	25.2	33.8	33.8
	Completed	337	49.3	66.2	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D47 **W4T4: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	173	25.3	34.0	34.0
	Completed	336	49.2	66.0	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D48 **W4T5: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	173	25.3	34.0	34.0
	Completed	336	49.2	66.0	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D49 **W4T6: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	173	25.3	34.0	34.0
	Completed	336	49.2	66.0	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D50 **W4T7: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	174	25.5	34.2	34.2
	Completed	335	49.0	65.8	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D51 **W4T8: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	174	25.5	34.2	34.2
	Completed	335	49.0	65.8	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D52 **W4T9: Activity**		Frequency	%	Valid %	Cumulative %
	Not Completed	174	25.5	34.2	34.2
	Completed	335	49.0	65.8	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D53

W4T10: Activity		Frequency	%	Valid %	Cumulative %
	Not Completed	175	25.6	34.4	34.4
	Completed	334	48.9	65.6	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D54

Week 4: Additional Resources		Frequency	%	Valid %	Cumulative %
	Not Completed	187	27.4	36.7	36.7
	Completed	322	47.1	63.3	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D55

Week 4: Discussion Forum		Frequency	%	Valid %	Cumulative %
	Not Completed	184	26.9	36.1	36.1
	Completed	325	47.6	63.9	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

D56

Week 4: Final Assessment Quiz		Frequency	%	Valid %	Cumulative %
	Not Completed	192	28.1	37.7	37.7
	Completed	317	46.4	62.3	100.0
	Total	509	74.5	100.0	
Missing	System	174	25.5		
Total		683	100.0		

APPENDIX Z: DIRECT LOGIC REGRESSION OF WEEKLY ACTIVITY PROGRESSION.

Activity		B	S.E.	Wald	df	p	Odds Ratio	95% C.I.for C.I. for Odds Ratio	
								Lower	Upper
1	Wk1ModAct	2.98	0.99	8.95	1	0.00	19.60	2.79	137.64
2	W1T1Act	-3.03	1.39	4.75	1	0.03	0.05	0.00	0.74
3	W1T2Act	-0.98	1.80	0.30	1	0.58	0.37	0.01	12.65
4	W1T3Act	1.93	1.81	1.15	1	0.28	6.92	0.20	238.68
5	W1T4Act	0.91	1.50	0.37	1	0.54	2.50	0.13	47.54
6	W1T5Act	0.52	1.76	0.09	1	0.77	1.68	0.05	53.38
7	W1T6Act	-1.93	2.50	0.60	1	0.44	0.14	0.00	19.34
8	W1T7Act	-16.00	40192.88	0.00	1	1.00	0.00	0.00	
9	W1T8Act	17.01	40192.88	0.00	1	1.00	2.43E+07	0.00	
10	W1T9Act	1.82	1.84	0.98	1	0.32	6.20	0.17	230.15
11	W1T10Act	-0.90	1.84	0.24	1	0.62	0.41	0.01	14.85
12	Wk1AddRes	-1.16	1.08	1.17	1	0.28	0.31	0.04	2.58
13	Wk1DisFor	2.15	1.03	4.33	1	0.04	8.56	1.13	64.74
14	Wk1FinAss	-1.46	0.83	3.10	1	0.08	0.23	0.05	1.18
15	Wk2ModAct	-1.79	0.95	3.54	1	0.06	0.17	0.03	1.08
16	W2T1Act	-18.67	20856.65	0.00	1	1.00	0.00	0.00	
17	W2T2Act	-1.05	33927.96	0.00	1	1.00	0.35	0.00	
18	W2T3Act	0.95	38993.89	0.00	1	1.00	2.60	0.00	
19	W2T4Act	0.47	40151.65	0.00	1	1.00	1.60	0.00	
20	W2T5Act	0.00	49226.11	0.00	1	1.00	1.00	0.00	
21	W2T6Act	-3.33	49226.11	0.00	1	1.00	0.04	0.00	
22	W2T7Act	19.18	56029.69	0.00	1	1.00	2.14E+08	0.00	
23	W2T8Act	-3.32	68930.96	0.00	1	1.00	0.04	0.00	
24	W2T9Act	2.62	49192.38	0.00	1	1.00	13.70	0.00	
25	W2T10Act	1.51	2.21	0.47	1	0.49	4.53	0.06	343.70
26	Wk2AddRes	-0.70	2.43	0.08	1	0.77	0.50	0.00	58.00
27	Wk2DisFor	1.96	1.20	2.67	1	0.10	7.09	0.68	74.46
28	Wk2FinAss	0.33	0.80	0.18	1	0.67	1.40	0.29	6.66
29	Wk3ModAct	2.98	1.50	3.93	1	0.05	19.64	1.04	372.45
30	W3T1Act	-21.09	23125.13	0.00	1	1.00	0.00	0.00	
31	W3T2Act	-0.15	46370.72	0.00	1	1.00	0.86	0.00	
32	W3T3Act	20.20	40192.93	0.00	1	1.00	5.93E+08	0.00	
33	W3T4Act	-20.20	40193.05	0.00	1	1.00	0.00	0.00	
34	W3T5Act	0.33	56841.48	0.00	1	1.00	1.40	0.00	
35	W3T6Act	19.08	40192.94	0.00	1	1.00	1.93E+08	0.00	
36	W3T7Act	1.23	1.68	0.53	1	0.47	3.42	0.13	92.97
37	W3T8Act	-0.41	1.57	0.07	1	0.79	0.66	0.03	14.36
38	W3T9Act	-0.80	1.35	0.35	1	0.56	0.45	0.03	6.39
39	W3T10Act	0.29	0.82	0.13	1	0.72	1.34	0.27	6.68
40	W3AddRes	22.68	40192.93	0.00	1	1.00	7.06E+09	0.00	
41	W3DisFor	-42.41	56841.39	0.00	1	1.00	0.00	0.00	
42	W3FinAss	62.78	85242.63	0.00	1	1.00	1.85E+27	0.00	
43	Wk4ModAct	-42.99	75172.03	0.00	1	1.00	0.00	0.00	
44	W4T1Act	-1.39	1.78	0.61	1	0.43	0.25	0.01	8.11
45	W4T2Act	3.15	1.93	2.68	1	0.10	23.40	0.54	1022.25
46	W4T3Act	2.42	0.89	7.33	1	0.01	11.19	1.95	64.32
Constant		-2.96	0.83	12.67	1	0.00	0.05		

Note: Variable significance levels $p<.05$ are highlighted in green.

APPENDIX AA: DESCRIPTIVE STATISTICS AND CATEGORICAL FREQUENCIES FOR MOOC LEARNERS.

Descriptive statistics for assessments and discussion variables for MOOC learners

Variable	n	Min	Max	Mean	Std. Dev	Skewness		Kurtosis	
						Statistic	S. E.	Statistic	S. E.
B1 Week 1 Quiz Result	384	0	10	8.84	1.554	-1.839	.125	4.598	.248
B2 Week 2 Quiz Result	318	5	10	9.30	1.102	-1.720	.137	2.444	.273
B3 Week 3 Quiz Result	295	0	10	9.11	1.430	-2.523	.142	8.957	.283
B4 Week 4 Quiz Result	278	5	10	9.16	1.108	-1.649	.146	2.525	.291
B5 Weekly Final Assessment Score	543	0	40	21.40	16.971	-.199	.105	-1.750	.209
B6 % Course Completed	543	0	1.00	0.66	0.412	-.546	.105	-1.515	.209
C1 Week 1: Discussion Number	299	1	3.00	1.08	0.291	3.982	.141	16.628	.281
C2 Week 2: Discussion Number	245	1	7.00	1.06	0.421	12.011	.156	164.951	.310
C3 Week 3: Discussion Number	227	1	8.00	1.06	0.541	11.181	.162	132.652	.322
C4 Week 4: Discussion Number	216	1	7.00	1.06	0.474	10.531	.166	122.727	.330
C5 Total Discussions Number	543	0	23.00	2.26	2.462	1.614	.105	8.427	.209

Categorical frequencies for study variables for MOOC learners

A1 Primary Reason for MOOC	Frequency	%	Valid %	Cumulative %
I like the format (online)	43	7.9	7.9	7.9
I enjoy learning about topics that interest me	264	48.6	48.6	56.5
I enjoy being part of a community of learners	27	5.0	5.0	61.5
I hope to gain skills for a new career	105	19.3	19.3	80.8
I hope to gain skills for a promotion at work	42	7.7	7.7	88.6
I am preparing to go back to school	10	1.8	1.8	90.4
I am preparing for college for the first time	4	.7	.7	91.2
I am curious about MOOCs	28	5.2	5.2	96.3
I want to try Canvas Network	12	2.2	2.2	98.5
Other	8	1.5	1.5	100.0
Total	543	100.0	100.0	

A2 **Type of Learner**	Frequency	%	Valid %	Cumulative %
An observer	38	7.0	7.0	7.0
A drop-in	30	5.5	5.5	12.5
A passive participant	162	29.8	29.8	42.4
An active participant	306	56.4	56.4	98.7
No response	7	1.3	1.3	100.0
Total	543	100.0	100.0	

A3 **Hours per Week**	Frequency	%	Valid %	Cumulative %
Less than 1 hour	14	2.6	2.6	2.6
Between 1 and 2 hours	122	22.5	22.5	25.0
Between 2 and 4 hours	220	40.5	40.5	65.6
Between 4 and 6 hours	112	20.6	20.6	86.2
Between 6 and 8 hours	40	7.4	7.4	93.6
More than 8 hours per week	28	5.2	5.2	98.7
No response	7	1.3	1.3	100.0
Total	543	100.0	100.0	

A4 **Level of Education**	Frequency	%	Valid %	Cumulative %
High School or College Preparatory School	41	7.6	7.6	7.6
Some college, but have not finished a degree	76	14.0	14.0	21.5
Completed 2-year college degree	44	8.1	8.1	29.7
Completed 4-year college degree	128	23.6	23.6	53.2
Some graduate school	55	10.1	10.1	63.4
Master's Degree (or equivalent)	129	23.8	23.8	87.1
PhD, JD, or MD (or equivalent)	40	7.4	7.4	94.5
None of these	16	2.9	2.9	97.4
No response	14	2.6	2.6	100.0
Total	543	100.0	100.0	

A5 **English Primary Language**	Frequency	%	Valid %	Cumulative %
No	233	42.9	42.9	42.9
Yes	302	55.6	55.6	98.5
No response	8	1.5	1.5	100.0
Total	543	100.0	100.0	

A6 **Place Living**	Frequency	%	Valid %	Cumulative %
America	130	23.9	23.9	23.9
Caribbean	11	2.0	2.0	26.0
Europe	95	17.5	17.5	43.5
Africa	96	17.7	17.7	61.1
Middle East	16	2.9	2.9	64.1
Asia	72	13.3	13.3	77.3
Russia	1	.2	.2	77.5
Australia & South Pacific	115	21.2	21.2	98.7
No response	7	1.3	1.3	100.0
Total	543	100.0	100.0	

A7 **Gender**	Frequency	%	Valid %	Cumulative %
Male	351	64.6	64.6	64.6
Female	178	32.8	32.8	97.4
No response	14	2.6	2.6	100.0
Total	543	100.0	100.0	

A8 **Age**	Frequency	%	Valid %	Cumulative %
19–24	98	18.0	18.0	18.0
25–34	152	28.0	28.0	46.0
35–44	129	23.8	23.8	69.8
45–54	93	17.1	17.1	86.9
55–64	49	9.0	9.0	95.9
65 or older	12	2.2	2.2	98.2
No response	10	1.8	1.8	100.0
Total	543	100.0	100.0	

A9 **Hear Course**	Frequency	%	Valid %	Cumulative %
Through a social media site (like Facebook or Twitter)	57	10.5	10.5	10.5
From a news story (print, online, radio, or TV) that mentioned	14	2.6	2.6	13.1
Canvas Network	28	5.2	5.2	18.2
From a friend or colleague	105	19.3	19.3	37.6
I clicked on an ad	23	4.2	4.2	41.8
From a web search	152	28.0	28.0	69.8
From the instructor	26	4.8	4.8	74.6
From a Canvas or Canvas Network communication	113	20.8	20.8	95.4
No response	25	4.6	4.6	100.0
Total	543	100.0	100.0	

A10 **Previous Online Course**	Frequency	%	Valid %	Cumulative %
Never taken an online course	111	20.4	20.4	20.4
At school	74	13.6	13.6	34.1
Canvas Network	126	23.2	23.2	57.3
Coursera	75	13.8	13.8	71.1
EdX	27	5.0	5.0	76.1
Udacity	15	2.8	2.8	78.8
Other	115	21.2	21.2	100.0
CIT	0	0	0	
Total	543	100.0	100.0	

A11 **Previous Online Experience**	Frequency	%	Valid %	Cumulative %
No	111	20.4	20.4	20.4
Yes	432	79.6	79.6	100.0
Total	543	100.0	100.0	

A12 **Positive Impact Course Material**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	15	2.8	5.6	5.6
	Disagree	2	.4	.7	6.3
	Neither Agree nor Disagree	9	1.7	3.4	9.7
	Agree	113	20.8	42.2	51.9
	Strongly Agree	129	23.8	48.1	100.0
	Total	268	49.4	100.0	
Missing	System	275	50.6		
Total		543	100.0		

A13 **Positive Impact Course Activities**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	11	2.0	4.2	4.2
	Disagree	4	.7	1.5	5.7
	Neither Agree nor Disagree	12	2.2	4.6	10.3
	Agree	126	23.2	47.9	58.2
	Strongly Agree	110	20.3	41.8	100.0
	Total	263	48.4	100.0	
Missing	System	280	51.6		
Total		543	100.0		

A14 **Course Hours Student Spends**		Frequency	%	Valid %	Cumulative %
	Less than 1 hour	5	.9	1.9	1.9
	Between 1 and 2 hours	39	7.2	14.9	16.8
	Between 2 and 4 hours	103	19.0	39.3	56.1
	Between 4 and 6 hours	64	11.8	24.4	80.5
	Between 6 and 8 hours	28	5.2	10.7	91.2
	More than 8 hours per week	23	4.2	8.8	100.0
	Total	262	48.3	100.0	
Missing	System	281	51.7		
Total		543	100.0		

A15 **Course Recommendation**		Frequency	%	Valid %	Cumulative %
	1 Not Likely	3	.6	1.2	1.2
	2	4	.7	1.5	2.7
	3	2	.4	.8	3.5
	4	2	.4	.8	4.2
	5 Neutral	11	2.0	4.2	8.5
	6	13	2.4	5.0	13.5
	7	30	5.5	11.5	25.0
	8	44	8.1	16.9	41.9
	9	29	5.3	11.2	53.1
	10 Very Likely	122	22.5	46.9	100.0
	Total	260	47.9	100.0	
Missing	System	283	52.1		
Total		543	100.0		

A16 Course Overall Rating Scale		Frequency	%	Valid %	Cumulative %
	1	5	.9	1.9	1.9
	2	6	1.1	2.3	4.2
	3	18	3.3	6.9	11.2
	4	95	17.5	36.5	47.7
	5 Highest	136	25.0	52.3	100.0
	Total	260	47.9	100.0	
Missing	System	283	52.1		
Total		543	100.0		

A17 Instructor Involvement		Frequency	%	Valid %	Cumulative %
	I like to learn on my own	59	10.9	22.8	22.8
	I prefer peer-to-peer interactions with my classmates (social learning)	12	2.2	4.6	27.4
	I prefer to communicate only with the instructor	31	5.7	12.0	39.4
	I like variety	147	27.1	56.8	96.1
	I do not interact with my instructor	10	1.8	3.9	100.0
	Total	259	47.7	100.0	
Missing	System	284	52.3		
Total		543	100.0		

A18 Length of Canvas Course		Frequency	%	Valid %	Cumulative %
	0–2 weeks	7	1.3	2.7	2.7
	2–4 weeks	89	16.4	34.2	36.9
	4–6 weeks	110	20.3	42.3	79.2
	6–8 weeks	31	5.7	11.9	91.2
	8 weeks or more	23	4.2	8.8	100.0
	Total	260	47.9	100.0	
Missing	System	283	52.1		
Total		543	100.0		

A19 Discipline Interest		Frequency	%	Valid %	Cumulative %
	Science	32	5.9	12.3	12.3
	Technology	121	22.3	46.5	58.8
	Engineering	23	4.2	8.8	67.7
	Humanities	22	4.1	8.5	76.2
	Social Science	27	5.0	10.4	86.5
	Business	15	2.8	5.8	92.3
	Applied Science	20	3.7	7.7	100.0
	Total	260	47.9	100.0	
Missing	System	283	52.1		
Total		543	100.0		

A20 **Video Interaction for Learning**		Frequency	%	Valid %	Cumulative %
	0 No comment	3	.6	1.2	1.2
	1 Interactive video content made no difference in my learning	50	9.2	19.7	20.9
	2	5	.9	2.0	22.8
	3	18	3.3	7.1	29.9
	4	29	5.3	11.4	41.3
	5	55	10.1	21.7	63.0
	6	26	4.8	10.2	73.2
	7 Interactive video content deepened my understanding of course topics	68	12.5	26.8	100.0
	Total	254	46.8	100.0	
Missing	System	289	53.2		
Total		543	100.0		

A21 **Video Interaction usage**		Frequency	%	Valid %	Cumulative %
	0 No comment	3	.6	1.2	1.2
	1 Difficult	15	2.8	5.9	7.1
	2	14	2.6	5.5	12.5
	3	9	1.7	3.5	16.1
	4	46	8.5	18.0	34.1
	5	36	6.6	14.1	48.2
	6	30	5.5	11.8	60.0
	7 Easy to use	102	18.8	40.0	100.0
	Total	255	47.0	100.0	
Missing	System	288	53.0		
Total		543	100.0		

A22 **Video Interaction for enjoyment**		Frequency	%	Valid %	Cumulative %
	0 No comment	3	.6	1.2	1.2
	1 I would not enjoy using Video Interaction again	19	3.5	7.5	8.7
	2	9	1.7	3.5	12.2
	3	13	2.4	5.1	17.3
	4	45	8.3	17.7	35.0
	5	45	8.3	17.7	52.8
	6	34	6.3	13.4	66.1
	7 I would enjoy using Video Interaction again	86	15.8	33.9	100.0
	Total	254	46.8	100.0	
Missing	System	289	53.2		
Total		543	100.0		

A23 **PDFs vs Video Interaction**		Frequency	%	Valid %	Cumulative %
	0 No comment	3	.6	2.1	2.1
	1 Did not use the Interactive PDFs	23	4.2	16.3	18.4
	2 I used the Interactive PDFs but preferred Video	10	1.8	7.1	25.5
	3 I used both Interactive PDFs and Video Interaction	55	10.1	39.0	64.5
	4 I used Video Interaction but preferred PDFs	18	3.3	12.8	77.3
	5 I only used the Interactive PDFs	32	5.9	22.7	100.0
	Total	141	26.0	100.0	
Missing	System	402	74.0		
Total		543	100.0		

A24 **Pre-course Learner Goals**		Frequency	%	Valid %	Cumulative %
	Better understanding of topic	118	21.7	29.1	29.1
	For personal interest	127	23.4	31.3	60.3
	Professional development	161	29.7	39.7	100.0
	Total	406	74.8	100.0	
Missing	System	137	25.2		
Total		543	100.0		

A25 **Pre-course Learner Experience**		Frequency	%	Valid %	Cumulative %
	Course delivery style	33	6.1	24.4	24.4
	Student learning experience	80	14.7	59.3	83.7
	Certification	22	4.1	16.3	100.0
	Total	135	24.9	100.0	
Missing	System	408	75.1		
Total		543	100.0		

A26 **Post-course Learner Goals**		Frequency	%	Valid %	Cumulative %
	Enhanced career development opportunities	46	8.5	39.3	39.3
	Improved knowledge of topic	71	13.1	60.7	100.0
	Total	117	21.5	100.0	
Missing	System	426	78.5		
Total		543	100.0		

A27 **Post-course Learner Experience**		Frequency	%	Valid %	Cumulative %
	Positive learning experience	154	28.4	70.6	70.6
	Variety of learning stimulus	42	7.7	19.3	89.9
	Instructor presence	22	4.1	10.1	100.0
	Total	218	40.1	100.0	
Missing	System	325	59.9		
Total		543	100.0		

A28 **Participation in Discussions**		Frequency	%	Valid %	Cumulative %
	No	211	38.9	38.9	38.9
	Yes	332	61.1	61.1	100.0
	Total	543	100.0	100.0	

A29 **Learner's Completed Course**	Frequency	%	Valid %	Cumulative %
No	255	47.0	47.0	47.0
Yes	288	53.0	53.0	100.0
Total	543	100.0	100.0	

Appendix AB: Descriptive statistics and categorical frequencies for completed MOOC learners.

Descriptive statistics for assessments and discussion variables for completed MOOC learners

Variable	n	Min	Max	Mean	Std. Dev	Skewness		Kurtosis	
						Statistic	S. E.	Statistic	S. E.
B1 Week 1 Quiz Result	285	4	10	9.05	1.348	-1.611	.144	2.499	.288
B2 Week 2 Quiz Result	277	5	10	9.38	1.023	-1.828	.146	3.043	.292
B3 Week 3 Quiz Result	276	4	10	9.22	1.151	-1.631	.147	2.243	.292
B4 Week 4 Quiz Result	273	5	10	9.18	1.088	-1.711	.147	2.892	.294
B5 Weekly Final Assessment Score	288	0	40	35.61	7.149	-2.995	.144	10.246	.286
B6 % Course Completed	288	.80	1.00	1.00	0.018	-8.741	.144	83.059	.286
C1 Week 1: Discussion Number	223	1	3.00	1.09	0.310	3.862	.163	15.619	.324
C2 Week 2: Discussion Number	216	1	7.00	1.06	0.443	11.618	.166	152.041	.330
C3 Week 3: Discussion Number	210	1	8.00	1.06	0.563	10.750	.168	122.581	.334
C4 Week 4: Discussion Number	209	1	7.00	1.06	0.481	10.357	.168	118.700	.335
C5 Total Discussions Number	288	0	23.00	3.64	2.495	1.502	.144	11.909	.286

Categorical frequencies for study variables for completed MOOC learners

A1 **Primary Reason for MOOC**	Frequency	%	Valid %	Cumulative %
I like the format (online)	29	10.1	10.1	10.1
I enjoy learning about topics that interest me	123	42.7	42.7	52.8
I enjoy being part of a community of learners	13	4.5	4.5	57.3
I hope to gain skills for a new career	64	22.2	22.2	79.5
I hope to gain skills for a promotion at work	22	7.6	7.6	87.2
I am preparing to go back to school	7	2.4	2.4	89.6
I am preparing for college for the first time	0.0	0.0	0.0	0.0
I am curious about MOOCs	18	6.3	6.3	95.8
I want to try Canvas Network	8	2.8	2.8	98.6
Other	4	1.4	1.4	100.0
Total	288	100.0	100.0	

A2 **Type of Learner**	Frequency	%	Valid %	Cumulative %
An observer	16	5.6	5.6	5.6
A drop-in	14	4.9	4.9	10.4
A passive participant	69	24.0	24.0	34.4
An active participant	186	64.6	64.6	99.0
No response	3	1.0	1.0	100.0
Total	288	100.0	100.0	

A3 **Hours per Week**	Frequency	%	Valid %	Cumulative %
Less than 1 hour	6	2.1	2.1	2.1
Between 1 and 2 hours	58	20.1	20.1	22.2
Between 2 and 4 hours	108	37.5	37.5	59.7
Between 4 and 6 hours	66	22.9	22.9	82.6
Between 6 and 8 hours	26	9.0	9.0	91.7
More than 8 hours per week	21	7.3	7.3	99.0
No response	3	1.0	1.0	100.0
Total	288	100.0	100.0	

A4 **Level of Education**	Frequency	%	Valid %	Cumulative %
High School or College Preparatory School	22	7.6	7.6	7.6
Some college, but have not finished a degree	36	12.5	12.5	20.1
Completed 2-year college degree	24	8.3	8.3	28.5
Completed 4-year college degree	73	25.3	25.3	53.8
Some graduate school	31	10.8	10.8	64.6
Master's Degree (or equivalent)	71	24.7	24.7	89.2
PhD, JD, or MD (or equivalent)	19	6.6	6.6	95.8
None of these	7	2.4	2.4	98.3
No response	5	1.7	1.7	100.0
Total	288	100.0	100.0	

A5 **English Primary Language**	Frequency	%	Valid %	Cumulative %
No	111	38.5	38.5	38.5
Yes	174	60.4	60.4	99.0
No response	3	1.0	1.0	100.0
Total	288	100.0	100.0	

A6 **Place Living**	Frequency	%	Valid %	Cumulative %
America	55	19.1	19.1	19.1
Caribbean	4	1.4	1.4	20.5
Europe	50	17.4	17.4	37.8
Africa	52	18.1	18.1	55.9
Middle East	5	1.7	1.7	57.6
Asia	44	15.3	15.3	72.9
Russia	1	.3	.3	73.3
Australia & South Pacific	74	25.7	25.7	99.0
No response	3	1.0	1.0	100.0
Total	288	100.0	100.0	

A7 **Gender**	Frequency	%	Valid %	Cumulative %
Male	181	62.8	62.8	62.8
Female	102	35.4	35.4	98.3
No response	5	1.7	1.7	100.0
Total	288	100.0	100.0	

A8 **Age**	Frequency	%	Valid %	Cumulative %
19–24	48	16.7	16.7	16.7
25–34	91	31.6	31.6	48.3
35–44	68	23.6	23.6	71.9
45–54	51	17.7	17.7	89.6
55–64	22	7.6	7.6	97.2
65 or older	5	1.7	1.7	99.0
No response	3	1.0	1.0	100.0
Total	288	100.0	100.0	

A9 **Hear Course**	Frequency	%	Valid %	Cumulative %
Through a social media site (like Facebook or Twitter)	28	9.7	9.7	9.7
From a news story (print, online, radio, or TV) that mentioned	6	2.1	2.1	11.8
Canvas Network	12	4.2	4.2	16.0
From a friend or colleague	66	22.9	22.9	38.9
I clicked on an ad	12	4.2	4.2	43.1
From a web search	81	28.1	28.1	71.2
From the instructor	21	7.3	7.3	78.5
From a Canvas or Canvas Network communication	51	17.7	17.7	96.2
No response	11	3.8	3.8	100.0
Total	288	100.0	100.0	

A10 **Previous Online Course**	Frequency	%	Valid %	Cumulative %
Never taken an online course	59	20.5	20.5	20.5
At school	38	13.2	13.2	33.7
Canvas Network	54	18.8	18.8	52.4
Coursera	43	14.9	14.9	67.4
EdX	14	4.9	4.9	72.2
Udacity	7	2.4	2.4	74.7
Other	73	25.3	25.3	100.0
CIT	0	0	0	
Total	288	100.0	100.0	

A11 **Previous Online Experience**	Frequency	%	Valid %	Cumulative %
No	59	20.5	20.5	20.5
Yes	229	79.5	79.5	100.0
Total	288	100.0	100.0	

A12 **Positive Impact Course Material**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	13	4.5	5.8	5.8
	Disagree	1	.3	.4	6.3
	Neither Agree nor Disagree	7	2.4	3.1	9.4
	Agree	91	31.6	40.8	50.2
	Strongly Agree	111	38.5	49.8	100.0
	Total	223	77.4	100.0	
Missing	System	65	22.6		
Total		288	100.0		

A13 **Positive Impact Course Activities**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	10	3.5	4.5	4.5
	Disagree	2	.7	.9	5.5
	Neither Agree nor Disagree	12	4.2	5.5	10.9
	Agree	104	36.1	47.3	58.2
	Strongly Agree	92	31.9	41.8	100.0
	Total	220	76.4	100.0	
Missing	System	68	23.6		
Total		288	100.0		

A14 **Course Hours Student Spends**		Frequency	%	Valid %	Cumulative %
	Less than 1 hour	2	.7	.9	.9
	Between 1 and 2 hours	29	10.1	13.2	14.2
	Between 2 and 4 hours	87	30.2	39.7	53.9
	Between 4 and 6 hours	55	19.1	25.1	79.0
	Between 6 and 8 hours	26	9.0	11.9	90.9
	More than 8 hours per week	20	6.9	9.1	100.0
	Total	219	76.0	100.0	
Missing	System	69	24.0		
Total		288	100.0		

A15 **Course Recommendation**		Frequency	%	Valid %	Cumulative %
	1 Not Likely	3	1.0	1.4	1.4
	2	2	.7	.9	2.3
	3	1	.3	.5	2.7
	4	1	.3	.5	3.2
	5 Neutral	8	2.8	3.7	6.8
	6	11	3.8	5.0	11.9
	7	25	8.7	11.4	23.3
	8	40	13.9	18.3	41.6
	9	24	8.3	11.0	52.5
	10 Very Likely	104	36.1	47.5	100.0
	Total	219	76.0	100.0	
Missing	System	69	24.0		
Total		288	100.0		

A16 **Course Overall Rating Scale**		Frequency	%	Valid %	Cumulative %
	1	5	1.7	2.3	2.3
	2	3	1.0	1.4	3.7
	3	14	4.9	6.4	10.0
	4	78	27.1	35.6	45.7
	5 Highest	119	41.3	54.3	100.0
	Total	219	76.0	100.0	
Missing	System	69	24.0		
Total		288	100.0		

A17 **Instructor Involvement**		Frequency	%	Valid %	Cumulative %
	I like to learn on my own	47	16.3	21.6	21.6
	I prefer peer-to-peer interactions with my classmates (social learning)	10	3.5	4.6	26.1
	I prefer to communicate only with the instructor	27	9.4	12.4	38.5
	I like variety	125	43.4	57.3	95.9
	I do not interact with my instructor	9	3.1	4.1	100.0
	Total	218	75.7	100.0	
Missing	System	70	24.3		
Total		288	100.0		

A18 **Length of Canvas Course**		Frequency	%	Valid %	Cumulative %
	0–2 weeks	6	2.1	2.7	2.7
	2–4 weeks	74	25.7	33.8	36.5
	4–6 weeks	95	33.0	43.4	79.9
	6–8 weeks	25	8.7	11.4	91.3
	8 weeks or more	19	6.6	8.7	100.0
	Total	219	76.0	100.0	
Missing	System	69	24.0		
Total		288	100.0		

A19 **Discipline Interest**		Frequency	%	Valid %	Cumulative %
	Science	30	10.4	13.7	13.7
	Technology	100	34.7	45.7	59.4
	Engineering	20	6.9	9.1	68.5
	Humanities	17	5.9	7.8	76.3
	Social Science	26	9.0	11.9	88.1
	Business	10	3.5	4.6	92.7
	Applied Science	16	5.6	7.3	100.0
	Total	219	76.0	100.0	
Missing	System	69	24.0		
Total		288	100.0		

A20 **Video Interaction for Learning**		Frequency	%	Valid %	Cumulative %
	0 No comment	3	1.0	1.4	1.4
	1 Interactive video content made no difference in my learning	44	15.3	20.7	22.1
	2	3	1.0	1.4	23.5
	3	13	4.5	6.1	29.6
	4	23	8.0	10.8	40.4
	5	47	16.3	22.1	62.4
	6	21	7.3	9.9	72.3
	7 Interactive video content deepened my understanding of course topics	59	20.5	27.7	100.0
	Total	213	74.0	100.0	
Missing	System	75	26.0		
Total		288	100.0		

A21 **Video Interaction usage**		Frequency	%	Valid %	Cumulative %
	0 No comment	3	1.0	1.4	1.4
	1 Difficult	14	4.9	6.5	7.9
	2	10	3.5	4.7	12.6
	3	8	2.8	3.7	16.4
	4	32	11.1	15.0	31.3
	5	32	11.1	15.0	46.3
	6	28	9.7	13.1	59.3
	7 Easy to use	87	30.2	40.7	100.0
	Total	214	74.3	100.0	
Missing	System	74	25.7		
Total		288	100.0		

A22 **Video Interaction for enjoyment**		Frequency	%	Valid %	Cumulative %
	0 No comment	3	1.0	1.4	1.4
	1 I would not enjoy using Video Interaction again	17	5.9	8.0	9.4
	2	4	1.4	1.9	11.3
	3	9	3.1	4.2	15.5
	4	36	12.5	16.9	32.4
	5	39	13.5	18.3	50.7
	6	32	11.1	15.0	65.7
	7 I would enjoy using Video Interaction again	73	25.3	34.3	100.0
	Total	213	74.0	100.0	
Missing	System	75	26.0		
Total		288	100.0		

A23 **PDFs vs Video Interaction**		Frequency	%	Valid %	Cumulative %
	0 No comment	3	1.0	2.7	2.7
	1 Did not use the Interactive PDFs	19	6.6	17.3	20.0
	2 I used the Interactive PDFs but preferred Video	7	2.4	6.4	26.4
	3 I used both Interactive PDFs and Video Interaction	39	13.5	35.5	61.8
	4 I used Video Interaction but preferred PDFs	15	5.2	13.6	75.5
	5 I only used the Interactive PDFs	27	9.4	24.5	100.0
	Total	110	38.2	100.0	
Missing	System	178	61.8		
Total		288	100.0		

A24 **Pre-course Learner Goals**		Frequency	%	Valid %	Cumulative %
	Better understanding of topic	69	24.0	30.9	30.9
	For personal interest	48	16.7	21.5	52.5
	Professional development	106	36.8	47.5	100.0
	Total	223	77.4	100.0	
Missing	System	65	22.6		
Total		288	100.0		

A25 **Pre-course Learner Experience**		Frequency	%	Valid %	Cumulative %
	Course delivery style	19	6.6	22.1	22.1
	Student learning experience	54	18.8	62.8	84.9
	Certification	13	4.5	15.1	100.0
	Total	86	29.9	100.0	
Missing	System	202	70.1		
Total		288	100.0		

A26 **Post-course Learner Goals**		Frequency	%	Valid %	Cumulative %
	Enhanced career development opportunities	36	12.5	38.3	38.3
	Improved knowledge of topic	58	20.1	61.7	100.0
	Total	94	32.6	100.0	
Missing	System	194	67.4		
Total		288	100.0		

A27 **Post-course Learner Experience**		Frequency	%	Valid %	Cumulative %
	Positive learning experience	123	42.7	72.4	72.4
	Variety of learning stimulus	30	10.4	17.6	90.0
	Instructor presence	17	5.9	10.0	100.0
	Total	170	59.0	100.0	
Missing	System	118	41.0		
Total		288	100.0		

A28 **Participation in Discussions**		Frequency	%	Valid %	Cumulative %
	No	54	18.8	18.8	18.8
	Yes	234	81.3	81.3	100.0
	Total	288	100.0	100.0	

A29 **Learner's Completed Course**	Frequency	%	Valid %	Cumulative %
No	0	0		
Yes	288	100.0	100.0	100.0
Total	288	100.0	100.0	100.0

APPENDIX AC: DESCRIPTIVE STATISTICS AND CATEGORICAL FREQUENCIES FOR COMPLETED SPOC AND ONLINE LEARNERS.

Descriptive statistics for assessments and discussion variables for completed SPOC and online learners

Variable	n	Min	Max	Mean	Std. Dev	Skewness		Kurtosis	
						Statistic	S. E.	Statistic	S. E.
B1 Week 1 Quiz Result	108	6	10	9.69	0.719	-2.686	.233	7.924	.461
B2 Week 2 Quiz Result	108	7	10	9.67	0.757	-2.508	.233	5.597	.461
B3 Week 3 Quiz Result	108	4	10	9.67	0.878	-3.889	.233	18.749	.461
B4 Week 4 Quiz Result	108	1	10	9.38	1.292	-3.456	.233	16.687	.461
B5 Weekly Final Assessment Score	108	21	40	38.43	2.987	-2.923	.233	11.247	.461
B6 % Course Completed	108	.18	1.00	0.97	0.122	-5.489	.233	31.053	.461
C1 Week 1: Discussion Number	38	1	2	1.05	0.226	4.174	.383	16.273	.750
C2 Week 2: Discussion Number	36	1	1	1.00	0.000	.	.	.	.
C3 Week 3: Discussion Number	35	1	1	1.00	0.000	.	.	.	.
C4 Week 4: Discussion Number	34	1	1	1.00	0.000	.	.	.	.
C5 Total Discussions Number	44	0	5	3.45	1.517	-1.292	.357	.518	.702

Categorical frequencies for study variables for completed SPOC and online learners

A1 **Primary Reason for MOOC**	Frequency	%	Valid %	Cumulative %
I like the format (online)	2	1.9	1.9	1.9
I enjoy learning about topics that interest me	18	16.7	16.7	18.5
I enjoy being part of a community of learners	6	5.6	5.6	24.1
I hope to gain skills for a new career	39	36.1	36.1	60.2
I hope to gain skills for a promotion at work	10	9.3	9.3	69.4
I am preparing to go back to school	12	11.1	11.1	80.6
I am preparing for college for the first time	0	0		
I am curious about MOOCs	17	15.7	15.7	96.3
I want to try Canvas Network	0	0		
Other	4	3.7	3.7	100.0
Total	108	100.0	100.0	

A2 Type of Learner	Frequency	%	Valid %	Cumulative %
An observer	0	0		
A drop-in	0	0		
A passive participant	17	15.7	15.7	15.7
An active participant	30	27.8	27.8	43.5
No response	61	56.5	56.5	100.0
Total	108	100.0	100.0	

A3 Hours per Week	Frequency	%	Valid %	Cumulative %
Less than 1 hour	0	0		
Between 1 and 2 hours	2	1.9	1.9	1.9
Between 2 and 4 hours	20	18.5	18.5	20.4
Between 4 and 6 hours	13	12.0	12.0	32.4
Between 6 and 8 hours	3	2.8	2.8	35.2
More than 8 hours per week	6	5.6	5.6	40.7
No response	64	59.3	59.3	100.0
Total	108	100.0	100.0	

A4 Level of Education	Frequency	%	Valid %	Cumulative %
High School or College Preparatory School	42	38.9	38.9	38.9
Some college, but have not finished a degree	7	6.5	6.5	45.4
Completed 2-year college degree	10	9.3	9.3	54.6
Completed 4-year college degree	27	25.0	25.0	79.6
Some graduate school	7	6.5	6.5	86.1
Master's Degree (or equivalent)	5	4.6	4.6	90.7
PhD, JD, or MD (or equivalent)	1	.9	.9	91.7
None of these	9	8.3	8.3	100.0
No response	0	0		
Total	108	100.0	100.0	

A5 English Primary Language	Frequency	%	Valid %	Cumulative %
No	11	10.2	10.2	10.2
Yes	97	89.8	89.8	100.0
No response				
Total	108	100.0	100.0	

A6 Place Living	Frequency	%	Valid %	Cumulative %
America	1	.9	.9	.9
Caribbean	0	0		
Europe	0	0		
Africa	0	0		
Middle East	0	0		
Asia	0	0		
Russia	0	0		
Australia & South Pacific	107	99.1	99.1	100.0
No response	0	0		
Total	108	100.0	100.0	

A7 **Gender**	Frequency	%	Valid %	Cumulative %
Male	41	38.0	38.0	38.0
Female	67	62.0	62.0	100.0
No response	0	0		
Total	108	100.0	100.0	

A8 **Age**	Frequency	%	Valid %	Cumulative %
19–24	25	23.1	23.1	23.1
25–34	31	28.7	28.7	51.9
35–44	31	28.7	28.7	80.6
45–54	15	13.9	13.9	94.4
55–64	6	5.6	5.6	100.0
65 or older	0	0		
No response	0	0		
Total	108	100.0	100.0	

A9 **Hear Course**	Frequency	%	Valid %	Cumulative %
Through a social media site (like Facebook or Twitter)	0	0		
From a news story (print, online, radio, or TV) that mentioned	1	.9	.9	.9
Canvas Network	0	0		
From a friend or colleague	2	1.9	1.9	2.8
I clicked on an ad	0	0		
From a web search	3	2.8	2.8	5.6
From the instructor	95	88.0	88.0	93.5
From a Canvas or Canvas Network communication	7	6.5	6.5	100.0
No response	0	0		
Total	108	100.0	100.0	

A10 **Previous Online Course**	Frequency	%	Valid %	Cumulative %
Never taken an online course	19	17.6	17.6	17.6
At school	5	4.6	4.6	22.2
Canvas Network	1	.9	.9	23.1
Coursera	0	0		
EdX	0	0		
Udacity	0	0		
Other	19	17.6	17.6	40.7
CIT	64	59.3	59.3	100.0
Total	108	100.0	100.0	

A11 **Previous Online Experience**	Frequency	%	Valid %	Cumulative %
No	19	17.6	17.6	17.6
Yes	89	82.4	82.4	100.0
Total	108	100.0	100.0	

A12 **Positive Impact Course Material**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	0	0		
	Disagree	0	0		
	Neither Agree nor Disagree	2	1.9	5.3	5.3
	Agree	22	20.4	57.9	63.2
	Strongly Agree	14	13.0	36.8	100.0
	Total	38	35.2	100.0	
Missing	System	70	64.8		
Total		108	100.0		

A13 **Positive Impact Course Activities**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	0	0		
	Disagree	0	0		
	Neither Agree nor Disagree	1	.9	2.6	2.6
	Agree	31	28.7	81.6	84.2
	Strongly Agree	6	5.6	15.8	100.0
	Total	38	35.2	100.0	
Missing	System	70	64.8		
Total		108	100.0		

A14 **Course Hours Student Spends**		Frequency	%	Valid %	Cumulative %
	Less than 1 hour	0	0		
	Between 1 and 2 hours	5	4.6	13.2	13.2
	Between 2 and 4 hours	13	12.0	34.2	47.4
	Between 4 and 6 hours	10	9.3	26.3	73.7
	Between 6 and 8 hours	5	4.6	13.2	86.8
	More than 8 hours per week	5	4.6	13.2	100.0
	Total	38	35.2	100.0	
Missing	System	70	64.8		
Total		108	100.0		

A15 **Course Recommendation**		Frequency	%	Valid %	Cumulative %
	1 Not Likely	1	.9	2.6	2.6
	2	0	0		
	3	0	0		
	4	0	0		
	5 Neutral	6	5.6	15.8	18.4
	6	3	2.8	7.9	26.3
	7	9	8.3	23.7	50.0
	8	11	10.2	28.9	78.9
	9	3	2.8	7.9	86.8
	10 Very Likely	5	4.6	13.2	100.0
	Total	38	35.2	100.0	
Missing	System	70	64.8		
Total		108	100.0		

A16
Course Overall Rating Scale

		Frequency	%	Valid %	Cumulative %
	1	0	0		
	2	1	.9	2.6	2.6
	3	7	6.5	18.4	21.1
	4	23	21.3	60.5	81.6
	5 Highest	7	6.5	18.4	100.0
	Total	38	35.2	100.0	
Missing	System	70	64.8		
Total		108	100.0		

A17
Instructor Involvement

		Frequency	%	Valid %	Cumulative %
	I like to learn on my own	11	10.2	28.9	28.9
	I prefer peer-to-peer interactions with my classmates (social learning)	2	1.9	5.3	34.2
	I prefer to communicate only with the instructor	10	9.3	26.3	60.5
	I like variety	15	13.9	39.5	100.0
	I do not interact with my instructor	0	0		
	Total	38	35.2		
Missing	System	70	64.8		
Total		108	100.0		

A18
Length of Canvas Course

		Frequency	%	Valid %	Cumulative %
	0–2 weeks	0	0		
	2–4 weeks	12	11.1	31.6	31.6
	4–6 weeks	19	17.6	50.0	81.6
	6–8 weeks	6	5.6	15.8	97.4
	8 weeks or more	1	.9	2.6	100.0
	Total	38	35.2	100.0	
Missing	System	70	64.8		
Total		108	100.0		

A19
Discipline Interest

		Frequency	%	Valid %	Cumulative %
	Science	15	13.9	39.5	39.5
	Technology	15	13.9	39.5	78.9
	Engineering	0	0		
	Humanities	0	0		
	Social Science	2	1.9	5.3	84.2
	Business	6	5.6	15.8	100.0
	Applied Science	0	0		
	Total	38	35.2	100.0	
Missing	System	70	64.8		
Total		108	100.0		

A20 **Video Interaction for Learning**		Frequency	%	Valid %	Cumulative %
	0 No comment	0	0		
	1 Interactive video content made no difference in my learning	8	7.4	25.0	25.0
	2	4	3.7	12.5	37.5
	3	2	1.9	6.3	43.8
	4	4	3.7	12.5	56.3
	5	6	5.6	18.8	75.0
	6	6	5.6	18.8	93.8
	7 Interactive video content deepened my understanding of course topics	2	1.9	6.3	100.0
	Total	32	29.6	100.0	
Missing	System	76	70.4		
Total		108	100.0		

A21 **Video Interaction usage**		Frequency	%	Valid %	Cumulative %
	0 No comment	0	0		
	1 Difficult	1	.9	3.1	3.1
	2	0	0		
	3	6	5.6	18.8	21.9
	4	4	3.7	12.5	34.4
	5	3	2.8	9.4	43.8
	6	7	6.5	21.9	65.6
	7 Easy to use	11	10.2	34.4	100.0
	Total	32	29.6	100.0	
Missing	System	76	70.4		
Total		108	100.0		

A22 **Video Interaction for enjoyment**		Frequency	%	Valid %	Cumulative %
	0 No comment	0	0		
	1 I would not enjoy using Video Interaction again	2	1.9	6.3	6.3
	2	2	1.9	6.3	12.5
	3	4	3.7	12.5	25.0
	4	8	7.4	25.0	50.0
	5	8	7.4	25.0	75.0
	6	3	2.8	9.4	84.4
	7 I would enjoy using Video Interaction again	5	4.6	15.6	100.0
	Total	32	29.6	100.0	
Missing	System	76	70.4		
Total		108	100.0		

A23 PDFs vs Video Interaction		Frequency	%	Valid %	Cumulative %
	0 No comment	0	0		
	1 Did not use the Interactive PDFs	2	1.9	7.1	7.1
	2 I used the Interactive PDFs but preferred Video	2	1.9	7.1	14.3
	3 I used both Interactive PDFs and Video Interaction	15	13.9	53.6	67.9
	4 I used Video Interaction but preferred PDFs	5	4.6	17.9	85.7
	5 I only used the Interactive PDFs	4	3.7	14.3	100.0
	Total	28	25.9	100.0	
Missing	System	80	74.1		
Total		108	100.0		

A24 Pre-course Learner Goals		Frequency	%	Valid %	Cumulative %
	Better understanding of topic	7	6.5	20.0	20.0
	For personal interest	4	3.7	11.4	31.4
	Professional development	24	22.2	68.6	100.0
	Total	35	32.4	100.0	
Missing	System	73	67.6		
Total		108	100.0		

A25 Pre-course Learner Experience		Frequency	%	Valid %	Cumulative %
	Course delivery style	12	11.1	50.0	50.0
	Student learning experience	7	6.5	29.2	79.2
	Certification	5	4.6	20.8	100.0
	Total	24	22.2	100.0	
Missing	System	84	77.8		
Total		108	100.0		

A26 Post-course Learner Goals		Frequency	%	Valid %	Cumulative %
	Enhanced career development opportunities	6	5.6	33.3	33.3
	Improved knowledge of topic	12	11.1	66.7	100.0
	Total	18	16.7	100.0	
Missing	System	90	83.3		
Total		108	100.0		

A27 Post-course Learner Experience		Frequency	%	Valid %	Cumulative %
	Positive learning experience	8	7.4	44.4	44.4
	Variety of learning stimulus	8	7.4	44.4	88.9
	Instructor presence	2	1.9	11.1	100.0
	Total	18	16.7	100.0	
Missing	System	90	83.3		
Total		108	100.0		

A28 Participation in Discussions		Frequency	%	Valid %	Cumulative %
	No	37	34.3	34.3	34.3
	Yes	71	65.7	65.7	100.0
	Total	108	100.0	100.0	

A29 **Learner’s Completed Course**	Frequency	%	Valid %	Cumulative %
No	0	0		
Yes	108	100.0	100.0	100.0
Total	108	100.0	100.0	100.0

Appendix AD: Frequencies for categorical study variables for SPOC learners.

Descriptive statistics for assessments and discussion variables for SPOC learners

Variable	n	Min	Max	Mean	Std. Dev	Skewness		Kurtosis	
						Statistic	S. E.	Statistic	S. E.
B1 Week 1 Quiz Result	45	8	10	9.85	0.423	-2.944	.354	8.718	.695
B2 Week 2 Quiz Result	44	7	10	9.83	0.523	-4.178	.357	20.216	.702
B3 Week 3 Quiz Result	44	9	10	9.88	0.355	-2.847	.357	7.084	.702
B4 Week 4 Quiz Result	44	8	10	9.76	0.554	-2.431	.357	4.786	.702
B5 Weekly Final Assessment Score	47	0	40	37.04	9.072	-3.666	.347	12.529	.681
B6 % Course Completed	47	.09	1.00	.8904	0.264	-2.341	.347	3.998	.681
C1 Week 1: Discussion Number	39	1	2	1.05	0.223	4.233	.378	16.779	.741
C2 Week 2: Discussion Number	36	1	1	1.00	0.000	.	.	.	.
C3 Week 3: Discussion Number	35	1	1	1.00	0.000	.	.	.	.
C4 Week 4: Discussion Number	34	1	1	1.00	0.000	.	.	.	.
C5 Total Discussions Number	47	0	5	3.26	1.661	-1.020	.347	-.387	.681

Categorical frequencies for study variables for SPOC learners

A1 **Primary Reason for MOOC**	Frequency	%	Valid %	Cumulative %
I like the format (online)	3	6.4	6.4	6.4
I enjoy learning about topics that interest me	11	23.4	23.4	29.8
I enjoy being part of a community of learners	6	12.8	12.8	42.6
I hope to gain skills for a new career	18	38.3	38.3	80.9
I hope to gain skills for a promotion at work	8	17.0	17.0	97.9
I am preparing to go back to school	1	2.1	2.1	100.0
I am preparing for college for the first time	0	0		
I am curious about MOOCs	0	0		
I want to try Canvas Network	0	0		
Other	0	0		
Total	47	100.0	100.0	

A2 Type of Learner	Frequency	%	Valid %	Cumulative %
An observer	0	0		
A drop-in	0	0		
A passive participant	18	38.3	38.3	38.3
An active participant	29	61.7	61.7	100.0
No response	0	0		
Total	47	100.0	100.0	

A3 Hours per Week	Frequency	%	Valid %	Cumulative %
Less than 1 hour	0	0		
Between 1 and 2 hours	2	4.3	4.3	4.3
Between 2 and 4 hours	21	44.7	44.7	48.9
Between 4 and 6 hours	15	31.9	31.9	80.9
Between 6 and 8 hours	3	6.4	6.4	87.2
More than 8 hours per week	6	12.8	12.8	100.0
No response	0	0		
Total	47	100.0	100.0	

A4 Level of Education	Frequency	%	Valid %	Cumulative %
High School or College Preparatory School	13	27.7	27.7	27.7
Some college, but have not finished a degree	7	14.9	14.9	42.6
Completed 2-year college degree	7	14.9	14.9	57.4
Completed 4-year college degree	5	10.6	10.6	68.1
Some graduate school	3	6.4	6.4	74.5
Master's Degree (or equivalent)	4	8.5	8.5	83.0
PhD, JD, or MD (or equivalent)	1	2.1	2.1	85.1
None of these	7	14.9	14.9	100.0
No response	0	0		
Total	47	100.0	100.0	

A5 English Primary Language	Frequency	%	Valid %	Cumulative %
No	2	4.3	4.3	4.3
Yes	45	95.7	95.7	100.0
No response	0	0		
Total	47	100.0	100.0	

A6 Place Living	Frequency	%	Valid %	Cumulative %
America	0	0		
Caribbean	0	0		
Europe	0	0		
Africa	0	0		
Middle East	0	0		
Asia	0	0		
Russia	0	0		
Australia & South Pacific	47	100.0	100.0	100.0
No response	0	0		
Total	47	100.0	100.0	

A7 Gender	Frequency	%	Valid %	Cumulative %
Male	13	27.7	27.7	27.7
Female	34	72.3	72.3	100.0
No response	0	0		
Total	108	100.0	100.0	

A8 Age	Frequency	%	Valid %	Cumulative %
19–24	11	23.4	23.4	23.4
25–34	11	23.4	23.4	46.8
35–44	16	34.0	34.0	80.9
45–54	7	14.9	14.9	95.7
55–64	2	4.3	4.3	100.0
65 or older	11	23.4	23.4	23.4
No response	0	0		
Total	47	100.0	100.0	

A9 Hear Course	Frequency	%	Valid %	Cumulative %
Through a social media site (like Facebook or Twitter)	0	0		
From a news story (print, online, radio, or TV) that mentioned	0	0		
Canvas Network	1	2.1	2.1	2.1
From a friend or colleague	3	6.4	6.4	8.5
I clicked on an ad	0	0		
From a web search	3	6.4	6.4	14.9
From the instructor	32	68.1	68.1	83.0
From a Canvas or Canvas Network communication	8	17.0	17.0	100.0
No response	0	0		
Total	47	100.0	100.0	

A10 Previous Online Course	Frequency	%	Valid %	Cumulative %
Never taken an online course	19	40.4	40.4	40.4
At school	5	10.6	10.6	51.1
Canvas Network	1	2.1	2.1	53.2
Coursera	1	2.1	2.1	55.3
EdX	0	0		
Udacity	0	0		
Other	21	44.7	44.7	100.0
CIT	0	0		
Total	47	100.0	100.0	

A11 Previous Online Experience	Frequency	%	Valid %	Cumulative %
No	19	40.4	40.4	40.4
Yes	28	59.6	59.6	100.0
Total	47	100.0	100.0	

A12 **Positive Impact Course Material**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	0	0		
	Disagree	0	0		
	Neither Agree nor Disagree	2	4.3	5.7	5.7
	Agree	21	44.7	60.0	65.7
	Strongly Agree	12	25.5	34.3	100.0
	Total	35	74.5	100.0	
Missing	System	12	25.5		
Total		47	100.0	100.0	

A13 **Positive Impact Course Activities**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	0	0		
	Disagree	0	0		
	Neither Agree nor Disagree	1	2.1	2.9	2.9
	Agree	28	59.6	80.0	82.9
	Strongly Agree	6	12.8	17.1	100.0
	Total	35	74.5	100.0	
Missing	System	12	25.5		
Total		47	100.0	100.0	

A14 **Course Hours Student Spends**		Frequency	%	Valid %	Cumulative %
	Less than 1 hour	0	0		
	Between 1 and 2 hours	6	12.8	17.1	17.1
	Between 2 and 4 hours	11	23.4	31.4	48.6
	Between 4 and 6 hours	9	19.1	25.7	74.3
	Between 6 and 8 hours	4	8.5	11.4	85.7
	More than 8 hours per week	5	10.6	14.3	100.0
	Total	35	74.5	100.0	
Missing	System	12	25.5		
Total		47	100.0	100.0	

A15 **Course Recommendation**		Frequency	%	Valid %	Cumulative %
	1 Not Likely	1	2.1	2.9	2.9
	2	0	0		
	3	0	0		
	4	0	0		
	5 Neutral	6	12.8	17.1	20.0
	6	3	6.4	8.6	28.6
	7	7	14.9	20.0	48.6
	8	10	21.3	28.6	77.1
	9	3	6.4	8.6	85.7
	10 Very Likely	5	10.6	14.3	100.0
	Total	35	74.5	100.0	
Missing	System	12	25.5		
Total		47	100.0	100.0	

A16 **Course Overall Rating Scale**		Frequency	%	Valid %	Cumulative %
	1	0	0		
	2	1	2.1	2.9	2.9
	3	6	12.8	17.1	20.0
	4	20	42.6	57.1	77.1
	5 Highest	8	17.0	22.9	100.0
	Total	35	74.5	100.0	
Missing	System	12	25.5		
Total		47	100.0	100.0	

A17 **Instructor Involvement**		Frequency	%	Valid %	Cumulative %
	I like to learn on my own	11	23.4	31.4	31.4
	I prefer peer-to-peer interactions with my classmates (social learning)	2	4.3	5.7	37.1
	I prefer to communicate only with the instructor	7	14.9	20.0	57.1
	I like variety	15	31.9	42.9	100.0
	I do not interact with my instructor	0	0		
	Total	35	74.5		
Missing	System	12	25.5		
Total		47	100.0	100.0	

A18 **Length of Canvas Course**		Frequency	%	Valid %	Cumulative %
	0–2 weeks	0	0		
	2–4 weeks	11	23.4	31.4	31.4
	4–6 weeks	17	36.2	48.6	80.0
	6–8 weeks	6	12.8	17.1	97.1
	8 weeks or more	1	2.1	2.9	100.0
	Total	35	74.5	100.0	
Missing	System	12	25.5		
Total		47	100.0	100.0	

A19 **Discipline Interest**		Frequency	%	Valid %	Cumulative %
	Science	14	29.8	40.0	40.0
	Technology	14	29.8	40.0	80.0
	Engineering	0	0		
	Humanities	0	0		
	Social Science	2	4.3	5.7	85.7
	Business	0	0		
	Applied Science	5	10.6	14.3	100.0
	Total	35	74.5	100.0	
Missing	System	12	25.5		
Total		47	100.0	100.0	

A20 **Video Interaction for Learning**		Frequency	%	Valid %	Cumulative %
	0 No comment	0	0		
	1 Interactive video content made no difference in my learning	9	19.1	28.1	28.1
	2	4	8.5	12.5	40.6
	3	2	4.3	6.3	46.9
	4	5	10.6	15.6	62.5
	5	6	12.8	18.8	81.3
	6	4	8.5	12.5	93.8
	7 Interactive video content deepened my understanding of course topics	2	4.3	6.3	100.0
	Total	32	68.1	100.0	
Missing	System	15	31.9		
Total		47	100.0	100.0	

A21 **Video Interaction usage**		Frequency	%	Valid %	Cumulative %
	0 No comment	0	0		
	1 Difficult	2	4.3	6.3	6.3
	2	0	0		
	3	6	12.8	18.8	25.0
	4	5	10.6	15.6	40.6
	5	3	6.4	9.4	50.0
	6	6	12.8	18.8	68.8
	7 Easy to use	10	21.3	31.3	100.0
	Total	32	68.1	100.0	
Missing	System	15	31.9		
Total		47	100.0	100.0	

A22 **Video Interaction for enjoyment**		Frequency	%	Valid %	Cumulative %
	0 No comment	0	0		
	1 I would not enjoy using Video Interaction again	3	6.4	9.4	9.4
	2	2	4.3	6.3	15.6
	3	5	10.6	15.6	31.3
	4	8	17.0	25.0	56.3
	5	7	14.9	21.9	78.1
	6	3	6.4	9.4	87.5
	7 I would enjoy using Video Interaction again	4	8.5	12.5	100.0
	Total	32	68.1	100.0	
Missing	System	15	31.9		
Total		47	100.0	100.0	

A23 **PDFs vs Video Interaction**		Frequency	%	Valid %	Cumulative %
	0 No comment	0	0		
	1 Did not use the Interactive PDFs	2	4.3	6.7	6.7
	2 I used the Interactive PDFs but preferred Video	2	4.3	6.7	13.3
	3 I used both Interactive PDFs and Video Interaction	15	31.9	50.0	63.3
	4 I used Video Interaction but preferred PDFs	5	10.6	16.7	80.0
	5 I only used the Interactive PDFs	6	12.8	20.0	100.0
	Total	30	63.8	100.0	
Missing	System	17	36.2		
Total		47	100.0	100.0	

A24 **Pre-course Learner Goals**		Frequency	%	Valid %	Cumulative %
	Better understanding of topic	7	14.9	18.4	18.4
	For personal interest	5	10.6	13.2	31.6
	Professional development	26	55.3	68.4	100.0
	Total	38	80.9	100.0	
Missing	System	9	19.1		
Total		47	100.0	100.0	

A25 **Pre-course Learner Experience**		Frequency	%	Valid %	Cumulative %
	Course delivery style	12	25.5	46.2	46.2
	Student learning experience	9	19.1	34.6	80.8
	Certification	5	10.6	19.2	100.0
	Total	26	55.3	100.0	
Missing	System	21	44.7		
Total		47	100.0	100.0	

A26 **Post-course Learner Goals**		Frequency	%	Valid %	Cumulative %
	Enhanced career development opportunities	6	12.8	31.6	31.6
	Improved knowledge of topic	13	27.7	68.4	100.0
	Total	19	40.4	100.0	
Missing	System	28	59.6		
Total		47	100.0	100.0	

A27 **Post-course Learner Experience**		Frequency	%	Valid %	Cumulative %
	Positive learning experience	8	17.0	42.1	42.1
	Variety of learning stimulus	9	19.1	47.4	89.5
	Instructor presence	2	4.3	10.5	100.0
	Total	19	40.4	100.0	
Missing	System	28	59.6		
Total		47	100.0	100.0	

A28 **Participation in Discussions**		Frequency	%	Valid %	Cumulative %
	No	6	12.8	12.8	12.8
	Yes	41	87.2	87.2	100.0
	Total	47	100.0	100.0	

A29 **Learner's Completed Course**	Frequency	%	Valid %	Cumulative %
No	3	6.4	6.4	6.4
Yes	44	93.6	93.6	100.0
Total	47	100.0	100.0	

APPENDIX AE: DESCRIPTIVE STATISTICS AND CATEGORICAL FREQUENCIES FOR ONLINE LEARNERS.

Descriptive statistics for assessments and discussion variables for online learners

Variable	n	Min	Max	Mean	Std. Dev	Skewness		Kurtosis	
						Statistic	S. E.	Statistic	S. E.
B1 Week 1 Quiz Result	93	0	10	8.04	3.544	-1.719	.250	1.278	.495
B2 Week 2 Quiz Result	93	0	10	7.88	3.727	-1.566	.250	0.689	.495
B3 Week 3 Quiz Result	93	0	10	7.43	4.042	-1.226	.250	-0.337	.495
B4 Week 4 Quiz Result	92	0	10	6.71	4.239	-.856	.251	-1.108	.498
B5 Weekly Final Assessment Score	93	0	40	29.99	14.323	-1.325	.250	0.179	.495
B6 % Course Completed	93	.00	1.00	.8025	0.341	-1.453	.250	0.425	.495
C1 Week 1: Discussion Number	30	1	2	1.30	0.466	.920	.427	-1.242	.833
C2 Week 2: Discussion Number	3	1	1	1.00	0.000	.	.	.	.
C3 Week 3: Discussion Number	4	1	1	1.00	0.000	.	.	.	.
C4 Week 4: Discussion Number	6	1	1	1.00	0.000	.	.	.	.
C5 Total Discussions Number	93	0	2	.56	0.729	.907	.250	-0.545	.495

Categorical frequencies for study variables for online learners

A1 Primary Reason for MOOC	Frequency	%	Valid %	Cumulative %
I like the format (online)	0	0		
I enjoy learning about topics that interest me	9	9.7	9.7	9.7
I enjoy being part of a community of learners	0			
I hope to gain skills for a new career	34	36.6	36.6	46.2
I hope to gain skills for a promotion at work	5	5.4	5.4	51.6
I am preparing to go back to school	14	15.1	15.1	66.7
I am preparing for college for the first time	0	0		
I am curious about MOOCs	25	26.9	26.9	93.5
I want to try Canvas Network				
Other	6	6.5	6.5	100.0
Total	93	100.0	100.0	

There are no data for online learners for A2–A3.

A4 **Level of Education**	Frequency	%	Valid %	Cumulative %
High School or College Preparatory School	36	38.7	38.7	38.7
Some college, but have not finished a degree	3	3.2	3.2	41.9
Completed 2-year college degree	37	39.8	39.8	81.7
Completed 4-year college degree	5	5.4	5.4	87.1
Some graduate school	4	4.3	4.3	91.4
Master's Degree (or equivalent)	3	3.2	3.2	41.9
PhD, JD, or MD (or equivalent)				
None of these	8	8.6	8.6	100.0
No response				
Total	93	100.0	100.0	

A5 **English Primary Language**	Frequency	%	Valid %	Cumulative %
No	15	16.1	16.1	16.1
Yes	78	83.9	83.9	100.0
No response				
Total	93	100.0	100.0	

A6 **Place Living**	Frequency	%	Valid %	Cumulative %
America	1	1.1	1.1	1.1
Caribbean	0	0		
Europe	0	0		
Africa	0	0		
Middle East	0	0		
Asia	0	0		
Russia	0	0		
Australia & South Pacific	92	98.9	98.9	100.0
No response	0	0		
Total	93	100.0	100.0	

A7 **Gender**	Frequency	%	Valid %	Cumulative %
Male	36	38.7	38.7	38.7
Female	56	60.2	60.2	98.9
No response	1	1.1	1.1	100.0
Total	93	100.0	100.0	

A8 **Age**	Frequency	%	Valid %	Cumulative %
19–24	19	20.4	20.4	20.4
25–34	29	31.2	31.2	51.6
35–44	22	23.7	23.7	75.3
45–54	15	16.1	16.1	91.4
55–64	8	8.6	8.6	100.0
65 or older	0	0		
No response	0	0		
Total	93	100.0	100.0	

A9 **Hear Course**	Frequency	%	Valid %	Cumulative %
Through a social media site (like Facebook or Twitter)	0	0		
From a news story (print, online, radio, or TV) that mentioned	0	0		
Canvas Network	0	0		
From a friend or colleague	0	0		
I clicked on an ad	0	0		
From a web search	0	0		
From the instructor	93	100.0	100.0	100.0
From a Canvas or Canvas Network communication	0	0		
No response	0	0		
Total	93	100.0	100.0	

A10 **Previous Online Course**	Frequency	%	Valid %	Cumulative %
Never taken an online course	0	0		
At school	0	0		
Canvas Network	0	0		
Coursera	0	0		
EdX	0	0		
Udacity	0	0		
Other	0	0		
CIT	93	100.0	100.0	100.0
Total	93	100.0	100.0	

A11 **Previous Online Experience**	Frequency	%	Valid %	Cumulative %
No	0	0		
Yes	93	100.0	100.0	100.0
Total	93	100.0	100.0	

There are no data for online learners for A12–A27.

A28 **Participation in Discussions**	Frequency	%	Valid %	Cumulative %
No	54	58.1	58.1	58.1
Yes	39	41.9	41.9	100.0
Total	93	100.0	100.0	

A29 **Learner’s Completed Course**	Frequency	%	Valid %	Cumulative %
No	29	31.2	31.2	31.2
Yes	64	68.8	68.8	100.0
Total	93	100.0	100.0	

Appendix AF: CIT Subject Evaluation Frequency Distributions.

E1 **Course Rating**		Frequency	%	Valid %	Cumulative %
	1 Poor	0			
	2 Fair	0			
	3 Good	3	12.5	12.5	12.5
	4 Very Good	7	29.2	29.2	41.7
	5 Excellent	14	58.3	58.3	100.0
Total		24	100.0	100.0	

E2 **Subject Objectives Met**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	0			
	Disagree	3	12.5	12.5	12.5
	Neutral	0			
	Agree	12	50.0	50.0	62.5
	Strongly Agree	9	37.5	37.5	100.0
Total		24	100.0	100.0	

E3 **Subject Guide was Clear**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	0			
	Disagree	0			
	Neutral	3	12.5	12.5	12.5
	Agree	12	50.0	50.0	62.5
	Strongly Agree	9	37.5	37.5	100.0
Total		24	24	100.0	100.0

E4 **Time Allocation was Sufficient**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	0			
	Disagree	0			
	Neutral	1	4.2	4.2	4.2
	Agree	15	62.5	62.5	66.7
	Strongly Agree	8	33.3	33.3	100.0
Total		24	100.0	100.0	

E5 **Resources were Sufficient**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	0			
	Disagree	0			
	Neutral	0			
	Agree	15	62.5	62.5	62.5
	Strongly Agree	9	37.5	37.5	100.0
Total		24	100.0	100.0	

E6 **Resources were Easy to Use**		Frequency	%	Valid %	Cumulative %
	Strongly Disagree	0			
	Disagree	0			
	Neutral	0			
	Agree	15	62.5	62.5	62.5
	Strongly Agree	9	37.5	37.5	100.0
Total		24	100.0	100.0	

E7 **Resources were at Level**	Frequency	%	Valid %	Cumulative %
Strongly Disagree	0			
Disagree	2	8.3	8.3	8.3
Neutral	0			
Agree	15	62.5	62.5	70.8
Strongly Agree	7	29.2	29.2	100.0
Total	24	100.0	100.0	

E8 **Teacher was Knowledgeable**	Frequency	%	Valid %	Cumulative %
Strongly Disagree	0			
Disagree	0			
Neutral	0			
Agree	13	54.2	54.2	54.2
Strongly Agree	11	45.8	45.8	100.0
Total	24	100.0	100.0	

E9 **Teacher was Approachable**	Frequency	%	Valid %	Cumulative %
Strongly Disagree	0			
Disagree	0			
Neutral	2	8.3	8.3	8.3
Agree	13	54.2	54.2	62.5
Strongly Agree	9	37.5	37.5	100.0
Total	24	100.0	100.0	

E10 **Teacher Explained Things Well**	Frequency	%	Valid %	Cumulative %
Strongly Disagree	0			
Disagree	0			
Neutral	5	20.8	20.8	20.8
Agree	9	37.5	37.5	58.3
Strongly Agree	10	41.7	41.7	100.0
Total	24	100.0	100.0	

E11 **Teacher Encouraged Participation**	Frequency	%	Valid %	Cumulative %
Strongly Disagree	0			
Disagree	0			
Neutral	4	16.7	16.7	16.7
Agree	11	45.8	45.8	62.5
Strongly Agree	9	37.5	37.5	100.0
Total	24	100.0	100.0	

E12 **Teacher used Innovative Techniques**	Frequency	%	Valid %	Cumulative %
Strongly Disagree	0			
Disagree	0			
Neutral	1	4.2	4.2	4.2
Agree	14	58.3	58.3	62.5
Strongly Agree	9	37.5	37.5	100.0
Total	24	100.0	100.0	

Appendix AG: Frequency Distributions of comparable CIT Subject Evaluation and Canvas User Experience Survey.

E1 & A16 **Course Rating**		Frequency	%	Valid %	Cumulative %
Online	1 Poor	0			
	2 Fair	0			
	3 Good	3	12.5	12.5	12.5
	4 Very Good	7	29.2	29.2	41.7
	5 Excellent	14	58.3	58.3	100.0
	Total	24	100.0	100.0	
MOOC & SPOC	1 Lowest	5	1.6	1.7	1.7
	2	7	2.3	2.3	4.0
	3	25	8.1	8.3	12.3
	4	119	38.4	39.7	52.0
	5 Highest	144	46.5	48.0	100.0
	Total	300	96.8	100.0	
Missing		10	3.2		
Total		310	100.0		

E5 & A12 **Resources Sufficient**		Frequency	%	Valid %	Cumulative %
Online	Strongly Disagree	0			
	Disagree	0			
	Neutral	0			
	Agree	15	62.5	62.5	62.5
	Strongly Agree	9	37.5	37.5	100.0
	Total	24	100.0	100.0	
MOOC & SPOC	Strongly Disagree	0			
	Disagree	0			
	Neither Agree or Disagree	11	3.5	3.6	9.1
	Agree	137	44.2	44.5	53.6
	Strongly Agree	143	46.1	46.4	100.0
	Total	308	99.4	100.0	
Missing		2	0.6		
Total		310	100.0		

E6 & A13 **Resources Easy to Understand**		Frequency	%	Valid %	Cumulative %
Online	Strongly Disagree	0			
	Disagree	0			
	Neutral	0			
	Agree	15	62.5	62.5	62.5
	Strongly Agree	9	37.5	37.5	100.0
	Total	24	100.0	100.0	
MOOC & SPOC	Strongly Disagree	11	3.5	3.6	3.6
	Disagree	4	1.3	1.3	5.0
	Neither Agree or Disagree	13	4.2	4.3	9.2
	Agree	159	51.3	52.5	61.7
	Strongly Agree	116	37.4	38.3	100.0
	Total	303	97.7	100.0	
Missing		7	2.3		
Total		310	100.0		